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THE AMERICAN GAS LIGHT JOURNAL

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PUBLISHER'S ANNOUNCEMENT.

The publishers of the JOURNAL ask the attention of advertisers to the fact that, to insure changes in advertisements the issue following the notification of such desire for change, the notification should be made not later than any time of Wednesday.

[OFFICIAL NOTICE.]

January Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, Dec. 30, 1898.

The next meeting of the Society of Gas Lighting will be held in "The Arena," No. 39 West 31st street, New York city, at 3 P.M., January 12th.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

THE STANDING OF ACETYLENE.—In the current issue of the JOURNAL we print the text of the last of a series of four lectures on "Acetylene," which lectures were delivered by Professor Vivian B. Lewes, before the Society of Arts, London, on certain named dates of November and December of last year. That Professor Lewes can lecture interestingly on gas may not be stated by us as anything new, for his name and fame as a dissector of the vesicles gaseous are well known to those who labor in our vaporous vineyard. But as it takes a man of men to admit that a preconceived theory of his was wrong, we must all agree that Professor Lewes is at once a Doctor and a man. Starting in 1895 with the assumption, born of trial and belief and advice, that carbide of calcium could be produced for from $15 to $20 per net ton, and basing his deductions on the future of acetylene gas as a commercial factor on such price, in 1898 he states the case as present actual business knowledge proves. So, we salute Professor Lewes as a scientist who tells the truth as he finds it. And, certainly, his consecutive and comprehensive story of the rise and development of calcic carbide and its derivatives is the accurate history so far of what may be accomplished under it. Meanwhile the JOURNAL may take some satisfaction to itself that the matter prepared for us by Mr. Bredel, and printed in the spring of 1895, did not err on the cheap side of the amount of money that it costs to *produce* a ton of calcic carbide, the electric current being the agent that perfected conversion.

THE GASHOLDER DISASTER.—The first investigation respecting the cause of the wreck of the Consolidated Gas Company's East 21st street holder, so far as the coroner's office is concerned, is set for to-day. Meanwhile speculation and theory are as usual going hand-in-hand, but none has as yet, with authority, been able to give an inkling why the deplorable affair occurred. The hearing before the coroner may not develop much, but it is certain the story told in that jury room will be awaited with eagerness by those interested in gas distribution.

OBITUARY NOTE.—MR. FREDERICK G. YUENGLING.—We regret to report the death of Mr. Frederick G. Yuengling, President of the Pottsville (Pa.) Gas Company, who passed away, at his home in that city,

on the 2d inst. Deceased, who was born in Pottsville, January 28, 1847, was the son of the late Mr. David G. Yuengling, who, in 1829, founded the brewing firm of David G. Yuengling & Son, of Pottsville, which firm has since been conservatively operated by the Yuengling family. He was actively identified with everything of solidity in the commercial life of Pottsville, and his relations regarding the social circles of his native city were of the responsible type and of the best. He is survived by his widow (formerly Miss Minna Dohrman, Brooklyn, N. Y.—they were married in 1876), a son and a daughter. The funeral services were held in Pottsville, the afternoon of the 5th inst.

AN ANONYMOUS CONTRIBUTION.—A letter received the 4th inst., which bears date of "Brooklyn, Jan. 3," and which is signed "House keeper," was handed us by Mr. George W. Graves. The text of the letter is appended:

Mr. George W. Graves—Sir: I have been much interested in your article, "Cooking by Gas," in the last number of AMERICAN GAS LIGHT JOURNAL. Will you kindly state in *your* paper what range you consider best for use of small family, and if it is a movable affair or a fixture—also, if the ordinary boiler in our kitchen can be heated, and the probable cost. You say different ranges consume different amounts of gas for accomplishing same work. Please say which is the most economical, and where they and the exhibition of cooking may be seen. Any details will be of service.

"Housekeeper" seems to be a trifle mixed. Mr. Graves did contrib ute quite a newsy article, in our January 2d issue, on "Exhibitions of Cooking by Gas;" but Mr. Graves does not own the JOURNAL, which has been for some years, and is now, solely owned by A. M. Callender & Co. In that understanding we advise "Housekeeper" to make direct application to Mr. Graves, who may be addressed at Rochester, N. Y., with the certainty that such communication will reach him.

NOTES.—Mr. James Walsh, President of the Calumet Gas Company, of Chicago, has issued the following notice: "To the holders of the Calumet Gas Company's gold mortgage 5 per cent. bonds.—In consequence of the consolidation of the Calumet Gas Company with the Peoples Gas Light and Coke Company, the outstanding bonds of the above issue are hereby called for payment, and will be taken up on presentation to the Equitable Trust Company, No. 185 Dearborn street, Chicago. Interest will cease January 1st, 1899."——The official title of the consolidated lighting interests of Trenton, N. J., is to be that of the Trenton Gas and Electric Company. As it looks just now, the engineering management of the Company will be intrusted to Mr. F. D. Moses, with Mr. Wilder F. Lawrence as his understudy.——At the annual meeting of the Auburn (N. Y.) Gas Light Company, the officers chosen were: Directors, E. H. Avery, D. M. Dunning, George B. Turner (who replaces the late Oscar F. Knapp), S. E. Payne, N. B. Eldred, D. A. Smith, J. W. Dunning, J. C. Reed and F. E. Hughitt; President, E. H. Avery; Secretary, James C. Reed; Treasurer and Superintendent, D. M. Dunning.——The Suburban Electric Light Company, of Covington, Ky., has offered the sum of $480,000 for the plant and franchises of the Covington Gas Light Company. It is thought the offer will be accepted, and it is further certain that the property is worth at least every cent of the bid price.——Mr. Thomas Dolan has decided to retire from the management of the woollen mills at Kensington, Pa., with which he has been so long and prosperously connected. It would seem as though his gas interests were large enough to absorb most of his business time.——We regret to state that the political situation at Minneapolis, Minn., was such as to necessitate the replacing of Mr. Alonzo D. Meeds by some one of a different political faith. Mr. Meeds, during his occupancy of the post of official gas inspector for Minneapolis, gained the respect of those with whom he came in official contact, and a whisper never was sounded that reflected upon his honesty.——Mr. John Cabot, whose name is so widely and favorably known in connection with "trays for gas works," writing under date of the 5th inst, among other things says: "1898 was a good year for tray work. We have filled 93 orders, some of them of large size, making over 43 carloads, and have now a contract with one party for about 30 cars, for delivery during 1899, with a prospect of an unusually good business in addition."——Write to Messrs. Henry Maurer & Son, 420 East 23d street, New York, for a copy of their interesting brochure entitled "Absolute Fireproofing."——The Fitchburg (Mass.) Gas and Electric Company has secured roomy and convenient office quarters in the Phœnix block.——The Norwalk (Conn.) Gas Supply Company has petitioned the General Assembly to amend its charter permitting it to manufacture and distribute electricity for lighting and power use.

Acetylene.—The Last of a Series of Four Lectures, by Prof. Vivian B. Lewes, before the Society of Arts, London.

LECTURE NO. 4.—*The Combustion of Acetylene.—Acetylene Burners.—Smoking and Carbonizing of Burners.—Burners for Heating.—Acetylene for Gas Engines.—Diluted Acetylene and its Applications.*

As I have before stated, it was in the autumn of 1894 that I first received a supply of American carbide, and in reporting on this material on 26th November of that year I wrote: "This gas, when mixed with an equal quantity of air, can be burned at a No. 4 Bray burner, and the illuminating power of the mixture would be equal to 65.7 candles per 5 cubic feet of gas consumed, which would give the acetylene an illuminating value of 131.4 candles per 5 cubic feet. The presence of an inert gas, such as the nitrogen in the air, is well known to exercise such a cooling power on the flame as to seriously reduce its illuminating value, and I find that if the acetylene be burned by itself at a suitable burner, it develops no less than 230 candle-power per 5 cubic feet of gas consumed." Further experiments made during December, 1894, with carefully purified gas, yielded a slightly higher result, and in the paper read before the Society in January, 1895, I gave the illuminating power of the gas, when burned under the best conditions, as being 240 candles.

A considerable amount of vagueness exists as to what is meant by the illuminating value of a gas, and the only assumption which can be arrived at is that it is the highest illuminating effect which can be produced from the gas without the aid of regeneration or artificial air supply other than that created by the flame itself. The proper combustion of any hydrocarbon gas, however rich, can be effected by supplying the flame with exactly the amount of air necessary to prevent smoking, and it is under these conditions that the highest illuminating effect possible with the particular burner is obtained. With flat flames the ratio between the air supplied and the gas consumed is governed by two factors: (1) The thickness of the flame; (2) the pressure under which the gas issues from the burner. When a gas issues from a burner under pressure, the uprush of the escaping gas mechanically draws in air, so that when consuming a poor coal gas in a flat flame the pressure has to be kept down, or too much air would be dragged in which would consume the hydrocarbons too rapidly, and so seriously affect the amount of light emitted, whilst, as the gas increases in illuminating value, more and more air is required for proper combustion, and this can be obtained by increasing the pressure at the burner.

Experience has shown that with ordinary sized, flat flame burners seven-tenths of an inch in pressure gives practically the best results with coal gas of the quality supplied in London, and up to a certain limit the same flat flame burner can be used for richer gases by increasing the pressure. When this limit is reached a thinner sheet of flame has to be employed—*i. e.*, a smaller burner used, low initial pressure resorted to, and then, by increasing pressure this can be made to consume gases of increasing value, until the pressure reaches a point at which the flame becomes distorted, when a still smaller burner has to be taken. By such means as these even acetylene, with its enormously high illuminating value, can be satisfactorily consumed, whilst by thickening the flame and reducing the pressure to the point at which the uprush almost ceases to cause a mingling of air with the flame and leaves the supplying of the oxygen to diffusion, even a poor gas can be made to develop its illuminating power.

On consuming acetylene from a No. 000 union jet burner, at all ordinary pressures a smoky flame is obtained, but on increasing the pressure to 4 inches, a magnificent flame results, free from smoke, and developing an illuminating value of 240 candles per 5 cubic feet of gas consumed. Slightly higher values have been obtained, but 240 may be taken as the average value under these conditions. This figure is the one quoted by most manufacturers of acetylene apparatus, who argue from it that acetylene is 15 times as valuable in illuminating power, volume for volume, as London coal gas. Such a comparison is, however, absolutely misleading, as in contrasting the value of acetylene with coal gas, one must bear in mind that the illuminating power of London gas is determined by consuming it at the rate of 5 cubic feet per hour in the London argand, whilst in practice any power from 8 to 90 candles can be obtained from this volume, according to the form of burner in which it is consumed. Although small flat flame burners only emit from 1 to 2 candles per cubic foot of gas consumed, good incandescent mantles will yield about 18 candles per cubic foot, and certainly 17 on the average, and as incandescent gas lighting is rapidly displacing other methods of burning gas, and as this tendency will be enormously

increased when the lapsing of the Welsbach monopoly reduces the price of the mantles to the figure now charged in Germany, it is evident that no calculation is fair that does not include this as a factor.

Moreover, a very short experience soon shows that burners consuming 1 cubic foot of acetylene per hour are the largest that can be practically used for domestic purposes, and taking such burners all round, 32 candles per cubic foot is a fair average of the light developed by them, although out of a big batch of burners you occasionally find a few which will go as high as 36 or even 40 candles per cubic foot. The influence which the size of the burner and the rate of consumption has upon the illuminating power of coal gas is well known and is shown in the following table:

Burner.	Candles per Cubic Foot.
Flat flame No. 7	2.44
" 6	2.15
" 5	1.87
" 4	1.74
" 3	1.63
" 2	1.22
" 1	0.85
" 0	0.59

As the consumption of acetylene is regulated by exactly the same factors as act in the case of coal gas, it is evident that the smaller the burner and consumption, the lower will be the candle power per cubic foot of the acetylene. In practice, with a one-half cubic foot burner 24 candles per cubic foot is a good result. Taking a series of burners of the Napheys type, obtained from Falk, Stadlemann & Co., Limited, the following results were obtained:

No of Burner.	Pressure. Inches.	Gas Consumed. Cubic Feet.	Light. Candles.	Light. Candles per Cubic Foot.
6	2.0	0.15	0.7938	5.3
8	"	0 275	3.2	11.6
15	"	0.40	8.0	20.0
25	"	0.65	17.0	26.6
30	"	0.70	23.0	32.5
40	"	1.00	34.0	34.0

From these considerations, it is evident that the only fair way to contrast the light obtainable from coal gas and acetylene is to take the incandescent burner on the one hand and the 1 cubic foot flat flame on the other. Then it is seen that instead of having 15 times the value of the coal gas as an illuminant, it has only about twice its power. The acetylene burner, however, has one advantage over the mantle, and that is that you can more or less regulate the light to the amount you require.

When acetylene is burned in air, under such conditions as to complete its combustion, it is converted into carbon dioxide and water vapor, the same compounds as are produced by all combustible hydrocarbons:

$$2C_2H_2+5O_2=4CO_2+2H_2O.$$

One cubic foot of acetylene requires 2½ cubic feet of oxygen. The researches of Dr. Gréhant have shown us that when burning with a smokeless flame no carbon monoxide can be detected in the products emitted by its combustion, and its sanitary position will, therefore, be defined by the amount of oxygen abstracted from the air and of carbon dioxide produced, as compared with other illuminants.

Taking the average sized room, which would be well lighted by an illumination equal to 64 standard candles, we find that this amount of light, from various illuminants, would yield the following results:

Illuminant.	Oxygen Removed from Air. Cubic Feet.	Products of Water Vapor. Cubic Feet.	Combustion Carbon Dioxide. Cubic Feet.
Sperm Candles	38.5	26.2	43.6
Paraffine Oil	24.9	14.0	39.8
London Gas—Batswing	26.1	29.4	19.2
Argand	23.0	25.6	17.0
Regenerative	10.6	8.3	5.2
Incandescent	3.1	4.6	1.8
Acetylene	5.0	2.0	4.0

So that, light for light, acetylene fouls the air less than any of our ordinary illuminants, with the exception of the incandescent gas burner.

In comparing the heating effect of various illuminants on the air of a room, it is necessary to determine the calorific value of the combustion of a cubic foot of the illuminating gas employed, and it is manifest, from theoretical considerations, that a highly endothermic compound like acetylene must have a far higher heating power than ordinary coal gas. The mean of a number of experiments made in Junker's calorimeter gave as the thermal value of the ordinary London gas supply 158 calories, whilst under the same conditions acetylene yielded 320. The theoretical amount of heat emitted by the combustion of a cubic foot of acetylene is 349.08 calories, but this would only be given by the absolutely pure and dried gas, and the experimental number determined in the calorimeter represents more truly the heating power of the moist gas under ordinarily existing conditions.

Taking now the case in which a room is lit up with a power equal to 64 candles, we find that if we call the heating effect produced by an incandescent mantle giving this amount of illumination 100, then:

Ratio of heat emitted to yield a light of 64 candles:

Incandescent mantle	100
Acetylene	115
London Argands	571
Flat flame burners	914

So that, for all practical purposes, the heating effect on the air by acetylene illumination is the same as with mantles.

When one comes to compare the cost of acetylene and coal gas, one is again stuck with admiration at the statements made by the advocates of acetylene as a rival to the well established coal gas industry. At the present time the wholesale price of carbide is £20 a ton, but I believe that, to fill large cash orders, it can be obtained at £16, at Foyers, which would mean at least £20 a ton at the works where it is to be decomposed and the gas distributed. The descomposition of carbide is not a costly operation, but at least 10 per cent. would have to be added to the price of the carbide for handling, water, repairs, interest on plant, purification, etc., and this would bring the price of the acetylene to £2 per 1,000 cubic feet in the holder. Coal gas in the holder, when made on the scale common in our big cities, costs about 1s. 2d. per 1,000 cubic feet, and about 100 per cent. has to be added to this to cover charges of distribution and profit. The power of doing this is dependent on the amount of gas sold, and whilst the South Metropolitan can make a fair profit on gas at 2s. 3d. a thousand, there are many small country works that cannot pay a dividend with gas at three times the price. With acetylene the smallness of the output would necessitate a heavy charge over cost price, and I should be surprised to find an installation of acetylene, even in a fair sized town, paying its way with a less charge than £3 per 1,000 cubic feet. Looked at from this point of view, it is at once manifest how absurd it is to talk of acetylene as a possible rival of coal gas, and the sooner this is realized the better will it be for the future of this brilliant illuminant.

Abroad, where coal gas is dear, it is possible, by taking the price of acetylene in the holder and comparing it with distributed coal gas to make acetylene out to be, light for light, as cheap as the latter when consumed in a flat flame burner, but even this method of calculation breaks down before the high light emissivity of the incandescent mantle. It is in those districts where no coal gas exists that the true field for acetylene is to be found, and here its ease of generation and the beauty of its light make it a pleasant companion after the greasy dimness of the candle or the smell of the oil lamp.

When I first attempted to burn acetylene I used the Bray nipples which could be had on the market, and found that I obtained very high illuminating effects, and could, for a time, continue the combustion in a satisfactory way, by using 3 or 4 inches pressure at the burner. This high pressure was, however, undesirable, and I then devised a cubic foot burner in which, by drilling the union jet holes of very small size and at a more obtuse angle, I was able to burn the gas at an inch pressure. About this period, also, Bray made specially small tips for use with acetylene. Both these nipples answered extremely well for a time, and developed from 30 to 36 candles per cubic foot of gas, but they both had the same weakness. After a few hundred hours they began to smoke, and as a smoking acetylene flame covers everything in a room with a thick deposit of soot in a very short space of time, such burners were manifestly not fitted for the work they had to perform. The trouble generally commenced with a filiform growth of carbon appearing at the nipple, which quickly distorted the flame and caused a cloud of soot flakes to descend. If the burner was cleaned and relighted the trouble commenced again in an hour or two, and the only thing to be done was to replace the nipple by a new one.

If the nipple had been burning some time and was then removed and broken, it was found to be carbonized for some depth into the material, showing that a liquid hydrocarbon had soaked into the material, and had been split up there by the heat, with deposition of carbon. The generally accepted idea was that the heat of the nipple polymerized some acetylene to benzene, and that this, forming a drop, did the mischief, and efforts to keep the burner cool were looked upon as a likely direction in which to search for sucess.

Whilst these troubles were going on in England, attempts had been

made in America to use acetylene diluted with a certain proportion of air, which permitted it to be burned in ordinary flat flame nipples, but the danger of such admixture being recognized, nipples of the same class as those used in England were employed, and the same troubles ensued. In France single jets made of glass were first employed, and then Risener and Luchaire, Ragot and others, made burners in which two jets of acetylene, coming from two tubes spaced some little distance apart, should impinge and splay each other out into a butterfly flame. Soon after, Bullier introduced the idea of sucking air into the flame at or just below the burner tip.

At this juncture the Napheys or Dolan burner was introduced in America, the principle employed being to use two small and widely separated jets, instead of the two openings of the union jet burner, and to make each jet a minute bunsen, in which each jet of acetylene dragged in from the base of the nipple enough air to surround and protect it whilst burning, from contact with the steatite. These burners were hailed with delight, and their success led to their being pirated right and left. But although they mark a very great improvement, and will burn for several hundred hours without smoking (unless in a fit of false economy the user insists on turning them down and leaving them for an hour or so, as two small separate flames, in which case they generally start smoking on being again turned on), the trouble is by no means got over, and a Napheys burner will often be found smoking as heartily as one of its more humble brethren.

The fact is that the cause of smoking is to be found quite as much in the generator as in the nipple, and over-heating during generation is undoubtedly a prime factor in this worrying phenomenon. If smoke or tar vapor be examined under a high microscopic power, it is seen that it consists of minute vesicles or bubbles, in a most marvellously active condition of movement, and fulfilling in a most perfect manner the con ception one forms of molecular motion. Ever bombarding each other, but never colliding, these small vesicles, filled with gaseous matter, continue their career, until some mechanical action bursts them and deposits the minute trace of liquid which formed the skin of the microscopic balloon. It is for this reason that the most successful forms of washer for extracting tar during the manufacture of gas consist of fine jets, or orifices, through which the gas passes at considerable velocity and comes in contact with a baffle which breaks up the vesicles, and any one with experience in carbureted water gas-making knows the trouble that arises from filiform growths of carbon, when, owing to an insufficient temperature in the cracking and superheating chambers, the carbureted gas contains vapors instead of permanent gaseous products.

When acetylene has been made in a generator at an uudue temperature, it carries with it benzene vapor, which, as it commences to condens, assumes this vesicular form, and on coming to the extremely minute holes which form the apertures of the burner, the mechanical scrubbing which it encounters causes the breaking up of the vesicles, and the decomposition of the benzene and the other hydrocarbons held in suspension by benzene which soak into the steatite and carbonize. The presence of finely divided carbon has a great effect in determining the decomposition of the acetylene itself, so that a rapid growth of carbon takes place at the burner, and no ordinary clearing of the deposited carbon from the exterior will ever make the nipple fit for constant use again, as the catalytic action of the carbon deposited in the pores of the steatite, which cannot be got rid of, causes the deposition of a fresh supply of carbon ; whilst when the benzene vapor gets past the nipple and burns, as it requires three times as much air as acetylene, it often starts smoking of the flame from this cause. The impurities in acetylene, other than vapors, also play a certain part in the choking of the burner, as if there be much phosphureted hydrogen in the gas, a small quantity of phosphoric acid is apt to be deposited in the burner nipple and helps to distort the aperture, and silica from siliciureted hydrogen has the same effect.

It will be found, with experience, that the smoking in a burner will be overcome quite as much by attention to the temperature in the generator as to the burner itself ; and where a generator which gives overheating is in use, a well-arranged scrubbing apparatus that would get rid of the benzene from the gas would be found a distinct advantage in stopping burner troubles, whilst when proper purification is introduced the burner trouble will be found to have been practically solved.

At the Acetylene Exhibition, held in Berlin early this year, all the newest forms of burner were shown, and the best burners of each class were tested at the Imperial Physical Institute, for consumption and light-giving power. It was found, after 18 hours' burning, that several had to be eliminated on account of their commencing to smoke. Thirty hours proved fatal to another batch, whilst a few only continued to give satisfactory results after that period, a result which shows that the same troubles which have been rife in England have been equally marked on the Continent. The results also obtained as to the candle power of these burners fully bear out the figures which I have obtained. It may be of interest, at this point, to record the candle power of some of the many burners which I have personally tested.

Date.	Name of Burner.	Inches. Pressure.	Gas Consumed. Cu. Ft.	Candles.	Candles Per Ft.	Candles per 5 Cu. Ft.
1894	Lewes.....	1.75	1.02	32.82	32.17	160.8
"	Bray 000.....	2.0	1.85	64.0	34.59	172.9
1895	Acetylene 4.....	1.5	0.5	12.0	24 0	120.0
1896	Napheys or Dolan	2.0	0.6	16.0	26.6	133.0
1897	Falk-Napheys...	2.5	0 5	11.0	22.0	110.0
"	"	2.5	0.75	20.0	26.0	130 0
1898	"	2.5	1.0	34.0	34.0	170 0
"	Nurnberg.....	2.5	1.0	36.0	36.0	180.0
"	Hera	2.5	0 8	26.0	32.5	162 5
"	Ideal.....	2.5	0.75	20.0	26.5	132.5
"	Billwiller.....	3.0	1.0	40.0	40.0	200.0

These really represent the best results obtainable by the combustion of acetylene under domestic conditions.

The Dolan or Napheys tip was a great advance at the time when it was introduced, but the arms which carried the tips were made of metal, and these were perpetuated in the first batch of piracies made. The effect of heat, after a time, is to slightly distort these arms, thus throwing the two jets of gas slightly out of line. This trouble has now been got over by making the arms of the burner entirely in steatite, which, although adding to the cost, is a distinct advantage.

The incandescent mantle has made such a revolution in coal gas lighting that it is not surprising that attempts should have been made to adapt acetylene for this purpose. The first thing which had to be done, when taking steps in this direction, was to construct an atmospheric burner which would satisfactorily consume the gas. One would expect that acetylene, when consumed in an atmospheric burner, would give an excessively hot flame, not only on account of its composition, but also on account of its endothermic character. Le Chatelier calculates that the temperature of a non-luminous acetylene flame will range from 2,100° to 2,420° C.; the temperature, of course, varying with the ratio of acetylene to air, as shown in the following calculations :

Acetylene.	Air.	Temperature.
7.4	92.6	2,420° C.
12.9	87.1	2,260 "
17.37	82.63	2,100 "

In order to make a Bunsen burner for acetylene, the tube has to be extremely narrow, and it is even then found to be very liable to flash back, whilst it needs a high pressure in order to bring about satisfactory combustion of the gas with an absolutely non-luminous flame. One of the chief difficulties which has to be overcome is due to the range over which mixtures of air and acetylene are explosive. This, as we have seen, lies between the limits of 3 per cent. and 82 per cent. of acetylene ; and it must also be remembered that the velocity of the explosion of a mixture of acetylene and air is greater than that of a mixture of air and coal gas. The propagation of the explosive wave down the burner tube cannot be satisfactorily stopped by the ordinary device of using wire gauze, on account of the low igniting point of acetylene and air mixtures ; whilst if high pressures are used, so that the rate of flow shall be greater than the velocity of propagation downwards, more air is sucked in by the uprush of the gas, and the velocity of the explosion is again increased. The best results have been obtained by taking a Bunsen burner in which a constriction in the air tube creates a high velocity at that point, which, on the principle of the Smithells flame separator, prevents the propagation downwards just at that point.

Le Chatelier has shown that the rate of propagation of an explosive mixture of air and acetylene depends upon the diameter of the tube through which the wave is being propagated, and he has worked out the limits between which the explosive wave would pass through tubes of certain diameters:

Diameter of Tube. Inches.	Explosion — Lower Limit.	Upper Limit.
1.57	2.9 per cent. acetylene.	64.4 per cent. acetylene.
1.18	3.1 " "	62.0 " "
0.79	3.5 " "	55.0 " "
0.24	4.0 " "	40.0 " "
0.16	4.5 " "	25.0 " "
0.08	5.0 " "	15.0 " "
0.03	7.7 " "	10.0 " "
0.02	0.0 " "	0.0 " "

It will be seen that in a tube of 0.02 inch, or 0.5 mm., in diameter, you have the propagation of the explosive wave ceasing.

These investigations have been used as a basis upon which to construct acetylene burners for heating purposes, and burners have been made by the Allgemeine Carbid und Acetylengas Company, of Berlin, in which, by means of constricted tubes, satisfactory consumption is insured. It is found that the diameter of the tube at the constriction must be in a definite proportion to the particular mixture of air and acetylene consumed, as the more air employed the greater must be the constriction in the strangulated portion of the tube. Such burners have a flame which is very valuable for heating purposes, and which gives a very intense temperature. The same company has also used these burners with incandescent mantles, of somewhat different shape and composition to those ordinarily employed, and states that the photometric result is 30 to 40 per cent. higher than that obtained by the combustion of pure acetylene alone. I have lately been experimenting with an acetylene Bunsen, and get much higher results than these; as with a Welsbach No. 2 mantle I have obtained as much as 90 candles per cubic foot of acetylene consumed. As far as I have gone, the mantle appears to be hardened and strengthened by the intense heat to which it is subjected; but it yet remains to be seen how the life of the mantle is affected by the intense temperature of the flame. Acetylene atmospheric burners are now also employed for heating, cooking and metallurgical operations on a small scale, and with a reduction in the price of the gas, these uses for it will undoubtedly open up a wide field of utility.

The value of acetylene in photographic work is now universally recognized, and Mr. W. H. Walmsey has determined its relative value, as compared with the ordinary sources of light, by determining the time needed to fully expose carefully prepared plates, with the following results:

Direct sunlight	1 second.
Acetylene, 1 cubic foot burner	3 "
Diffused daylight reflected from mirror	12 "
Incandescent mantle	24 "
Coal gas, Oil gas, Oil lamp	240 "

It is also being used to a certain extent for projection work; but it is not so well suited for this, as in common with multiple wick oil lamps and incandescent mantles the flame offers too large a surface of illumination. M. Molteni has attempted to determine the projection value of various illuminants by a photometric process, in the following way: The measurements were made with an ordinary lantern, the stage of which carried an opaque card in which was cut an aperture 0.7 cubic meter square, and the distance of the lantern from the screen was such that each side of the square on the screen measured 1 meter. The screen was replaced by a disk of paper, the opposite side being illuminated by a standard lamp burning 42 grammes of oil per hour. The distance of this lamp was varied, in order that equality of illumination might be obtained on the screen, and the photometric values of the lights were determined from the distance of this lamp.

Multiple wick lamp	1
Incandescent gas, No. 2 burner (no reflector)	1
Acetylene 1 burner (no reflector)	1.06
" 2 " "	1.70
" 3 " "	3.20
" 4 " "	4.10
" 5 " "	4.50
Limelight, alcohol and oxygen	5.80
" oxhydrogen	16.60
" etho-oxygen	18.50
Electric incandescent, 32-candle power	0.68
" " 50- " vertical	0.93
" " 50- " E horizontal	0.93
" " focus 100- "	3.82
" " E arc lamp 7 amperes	39.03
" " " 10 "	75.61
" " " 12 "	86.50
" " " 15 "	117.61
" " " 20 "	160.80

Carbide will probably some day become an important factor in the transmission of power, as a cubic foot of solid carbide weighs 62.26 kilos., or 137 pounds, and if of commercial purity would yield 685 cubic feet of acetylene, having a thermal value of nearly 232,215 calories. In practice, however, the weight of carbide which can be got into a cubic foot space is dependent on the size to which the material is broken; and with the ordinary commercial carbide, a fair average would be 80 pounds per cubic foot, yielding 400 cubic feet of acetylene gas, with a thermal value of 139,600 calories. It is at once manifest that solid carbide is as economical a method of transporting acetylene as if liquid acetylene itself were employed, as the liquid would only yield about 400 times its own volume of gas; and the carbide has the advantage of being practically safe in transit. There are several people at present working on the utilization of acetylene for gas motors; but there are many difficulties to be overcome before this is successfully accomplished, as the deposition of carbon, when the air supply is insufficient, and the violence of the explosion, are troublesome factors to be dealt with.

The trouble of completely consuming acetylene without smoking, in the early days of its inception, caused Dickerson and Suckert to attempt the combustion of acetylene diluted with air, and in 1894 it was in this way that the gas was consumed. But not only did the cooling action of the nitrogen lead to a considerable decrease in the illuminating power of the acetylene so diluted, but, as will have been seen from the experiments of Gerdes and others, a very serious risk was incurred, it becoming merely a question of the breadth of the delivery tubes and the rate of flow of the gas whether an explosive wave was propagated back to the mixing machine or not. It was on account of the danger of this that this process of burning it was abandoned in America. The idea has, however, cropped up from time to time since, and it has been used in both France and Holland to a certain extent, on a practical scale; and even at the present time an attempt is being made in Manchester to introduce a process by which acetylene can be so diluted with air as to burn in an ordinary Bray burner.

The danger of diluting acetylene with air being so manifest, attempts have from time to time been made to dilute it with other gaseous material, and in 1895 Bullier took out a patent for improvements in carbureting air and gas, in which he claims the use of acetylene for enriching water gas. Having apparently found that acetylene was useless for this purpose, he, later on in the same year, took out a second patent for diluting it with nitrogen.

It was about this time also that Mr. Gerdes commenced his experiments upon the enrichment of oil gas with acetylene, which have borne such ample fruit on the Continent. He showed that when oil gas is enriched with 25 per cent. of acetylene, a valuable increase in its illuminating power is obtained, without any danger of explosion of the mixture owing to heat or shock. This mixture is now employed to a very large extent on the Prussian railways. The quantity of carbide already used this year for this purpose has reached a total of 3,000 tons, and it is computed that before the end of next year 10,000 tons per annum will be needed.

In consequence of the great Continental success of this admixture, application was lodged at the Home Office to sanction such a mixture in England, under the ordinary railway carriage cylinder pressure of 10 atmospheres. The safety of the mixture, and of mixtures considerably richer in acetylene, was completely established by a series of tests carried out in the presence of the Home Office officials; and, in consequence, by an order of the Secretary of State, dated 28th March, 1898, a mixture of oil gas with 20 per cent. of acetylene is allowed to be used at a pressure not exceeding 150 pounds on the square inch.

In order to determine the increase in illuminating power given by various percentages of acetylene in oil gas, and whether the mixture could be employed with economy, the following experiments were instituted: Oil gas containing 20 per cent. of acetylene was compressed into a cylinder under a pressure of 10 atmospheres; some of the original oil gas being also compressed in a second cylinder to the same pressure. Both cylinders were then blown off to 5.8 atmospheres, and the illuminating power of each was taken under identical conditions. The burner used was a "40 liter" one, and the results were as follows:

		Illuminating Value.	
Pressure.	Gas Consumption.	Oil Gas.	Oil Gas and Acetylene.
5.8 atmos.	1 cubic foot.	7.4 candles.	15.6 candles.

An analysis of the gas showed that the mixture contained 22 per cent. of acetylene, although but 20 per cent. was originally added, the increase being due to the loss of some of the oil gas, some of the vapors of benzene and toluene in it condensing to the liquid state under the pressure. Working from these figures it will be seen that the addition of 22 per cent. of acetylene caused an increase of illuminating power of 110 per cent., or 100 per cent. with 20 per cent. of acetylene.

The original oil gas and the mixture of oil gas with acetylene were next determined photometrically in an ordinary railway carriage lamp, at angles below the horizontal, on the Dibdin radial photometer:

Oil Gas.

Angle.	Pressure.	Gas.	Candles.	Candles per Cubic Foot.
Horizontal.	1 inch	2 cubic feet	7.4	3.7
10	"	" "	8.0	4 0
20	"	" "	8.2	4.1
30	"	" "	8.2	4.1
40	"	" "	8.2	4 1
50	"	" "	8.2	4.0
60	"	" "	7.6	3.8
70	"	" "	7.8	3.9
80	"	" "	8.0	4.0

Average candles per cubic foot, 3.9

Oil Gas and Acetylene.

Horizontal.	1 inch	2 cubic feet	17.0	8.5
10	"	" "	17.0	8.5
20	"	" "	17.5	8.75
30	"	" "	18.0	9.0
40	"	" "	17.0	8.5
50	"	" "	17.0	8.5
60	"	" "	17.0	8.5
70	"	" "	16.5	8.25
80	"	" "	16.5	8.25

Average candles per cubic foot, 8.5.

This shows that the addition of 20 per cent. of acetylene increases the illuminating power of the oil gas by over 110 per cent., at all angles.

With regard to cost, as we have before seen, acetylene, at the present price of carbide, will cost about £1 18s. to £2 per 1,000 cubic feet in the holder; and 200 cubic feet will accordingly cost 7s. 8d. The compressed oil gas costs from 6s. to 12s. per 1,000. With oil gas at 8s. a 1,000, 800 cubic feet will cost 6s. 5d., so that the total cost of 1,000 cubic feet of the enriched gas will be 14s. 1d. But as the illuminating value of the mixture is double that of the plain oil gas, there is an economy of 1s. 11d. per 1,000. As the oil gas is dearer, the saving will be greater; and, *vice versa*, with cheap oil gas the addition of acetylene would not pay. With oil gas at 6s. 6d. per 1,000, there is practically no difference, but the advantages accruing from the use of acetylene would make the mixture more desirable than the plain gas. Amongst these advantages are that the cylinders would last for double the length of time they would with the oil gas, with the one charge, and there would be no formation of liquid hydrocarbons due to compression, with consequent revaporizing when the pressure is reduced, causing inequality in the illuminating power.

The whole question of diluting acetylene with other gases has had a very great interest for me, and I have made many experiments in order to determine how it is that when 10 per cent. of acetylene is added to a diluent such as blue water gas, carbon monoxide, or even hydrogen, the resulting mixture is practically non-luminous; and I have worked out the enrichment value for acetylene for all those gases which might be employed for its dilution. I soon discovered from these experiments that methane is the only diluent which sustains the illuminating power of the acetylene when mixed with it in small proportions; and the fact that the same phenomenon is observable in comparing the illuminating power of mixtures of gases containing only some 30 per cent. of methane gives at once a clue to the methods which must be adopted in making a diluting gas for acetylene.

It is perfectly obvious that in many places it would be a great advantage to have an illuminating gas of about 20-candle power for general distribution, in the same way as a good coal gas could be used, if such a mixture could be produced at a price comparing favorably with coal gas under the same conditions. Although it would be impossible to use pure methane as the diluent for acetylene, on account of the cost of its production, it is quite easy to make a diluting gas which shall contain 30 per cent. of methane at a comparatively low rate. In order to make this a slightly modified form of water gas generator is em ployed. The fuel having been blown up to incandescence by an air blast, tar, creosote oil, heavy oil residues, or practically any waste liquid hydrocarbon, is injected into the body of the incandescent fuel by a steam injector or atomizer. If these hydrocarbons were allowed to run into the fuel by themselves, they would simply be burned up to carbon and hydrogen; but steam being injected with them, the steam is decomposed by the fuel, with the formation of water gas, which, to a certain extent, envelops the hydrocarbon, and instead of its undergoing complete decomposition, it is broken down to methane and hydrogen, and mingles with the water gas, whilst any residual carbon is left behind in the fuel. It is quite possible by such means to make a diluting gas containing—

Hydrogen	45
Carbon monoxide	15
Methane	30
Unsaturated hydrocarbons	5
Carbon dioxide and nitrogen	5

This gas costs from 8d. to 10d. per 1,000 cubic feet, and has an initial illuminating value of about 10 to 12 candles. On mixing with it 5 per cent. of acetylene, a gas having an illuminating value of 18 to 20 candles is obtained, which, being a mixture of perfect gases, gives no trouble as regards layering, and which, having the same specific gravity and illuminating value as coal gas, can be distributed and burned in precisely the same way. It is also found that mixtures of this gas with 50 per cent. of acetylene are not detonated, when compressed for railway carriage lighting, by any temperature which it would be possible to attain in the cylinder, and it seems that this method of utilizing acetylene is pre-eminently the one which promises for it the largest and most remunerative future.

In concluding this course of lectures, I am impressed by the feeling that the limited time at my disposal has prevented me from doing full justice to my subject, and should have far preferred a course of forty rather than four lectures, in order to deal with the many important points and side issues which, of necessity, have been omitted; and I leave my subject with the sincere hope that as time wears on, those points which appear to us now to be difficulties will be made clear, and that in the future cheapened carbide will enable this beautiful hydrocarbon to take its proper place in the foremost ranks of our illuminants.

An Example of Social Decadence.

An editorial writer in the current number of *Appleton's Popular Science Monthly* remarks that the incessant incroachment of the Government upon the rights of the individual will produce social decadence is a truth that most Americans have yet to learn. With a light heart they are constantly approving scheme after scheme for social regeneration that involves some restriction upon freedom, or an increase of taxation, or both. It is not perhaps singular that the history of similar schemes in the past should possess no lesson for them. When President Eliot, of Harvard University, says that the experience of the Italian republics has no value for us, it is not to be expected that persons with less capacity to interpret the records of other times should attach little or no importance to them. But they ought not most certainly to maintain the same attitude toward the experience of the nations of to-day. It is to blind their eyes to what does not rest upon hearsay or upon dubious documents—to what admits of the clearest demonstration at the hands of living witnesses.

For this reason we urge upon all students of social science the study of the condition of the inhabitants of the black-earth region of Russia. In that field, one of the largest and most fruitful in the world for investigation, they will find the amplest evidence of the frightful havoc wrought by the abridgement of individual freedom and the seizure of private property in the form of taxes for public purposes. If it be said that Russia is an autocracy, and cannot therefore furnish instruction to a democracy like the United States, the answer is easy, if not obvious. Despotism, like gravitation, is the same all over the world. It makes no difference in the long run whether a law abridging freedom issues from the palace of a czar or from the legislative halls of a popular assembly. The individual objecting to it is obliged to regulate his life, not in accordance with his own notions, but in accordance with the notions of someone else. It makes no difference, either, whether taxation is imposed by an imperial edict or by a legislative vote. The citizens that have to bear it against their will contribute money for purposes that someone else only approves of. The only difference between Russia and the United States is that this kind of despotism has been carried to much greater lengths in one country than in the other. If, therefore, we can find out what the effect has been in Russia, we will be able to predict what the effect will be in the United States.

As every person familiar with Russia knows, the black earth region is one of the richest and most productive in the world. It ought to be inhabited by one of the wealthiest and happiest of peoples. Yet such is not the case. According to Count Tolstoi, who contributed recently a letter to the London *Times* on the subject, the inhabitants are among the poorest and most miserable in the world. They are in a state of chronic starvation. They are obliged to content themselves with nearly a third less food than is sufficient to maintain normal health. The physical effect of this insufficiency of food is a decrease in vitality, a diminished stature, and a check to the growth of population. It is proved,

first, by the failure of the peasants of the region to meet the requirements for military service, and, second, by the statistics of population, which show that the increase of births over deaths has fallen from the maximum reached 20 years ago to zero.

But the mental effects of the destitution wrought by the robberies of the Government are more distressing even than the physical. It gives birth to a stolidity and despair that tend to paralyze all effort toward betterment. The people subjected to it come to feel that there is no use of making any struggle beyond the maintenance of mere existence. Whatever they get in excess of this requirement will be taken from them. "A peasant," says Tolstoi, illustrating this fact, "feels that his position as an agriculturist is bad, but he believes that it can not be improved; and, consequently, adapting himself to this hopeless position, he no longer fights against it, but lives and acts only in so far as he is stirred by the instinct of self-preservation. Moreover, the very wretchedness of his condition increases still more his depression of spirit. The lower the economic condition of a population sinks, like a weight on a lever, the more difficult it becomes to raise it again; the peasants feel this, and, as it were, throw away the helve after the hatchet. 'Why should we trouble ourselves?' they say. 'We shan't get fat. If we can only keep alive.'"

The fruits of this mental state are as palpable as those of the lack of food. They are to be found in every direciion. In manners, habits and customs the peasants are hopelessly conservative. They belong, not to the nineteenth century, but to the ninth. Instead of adopting new and improved methods of agriculture, they cling to those of the subjects of Rurik. They use the old plow, distribute tillage in three crops, and divide their fields into long, narrow strips. So slowly do they toil with primitive implements and debilitated animals, and so indifferent are they to what they are doing, that it takes them a day to do the work that a well-fed and alert peasant would do in half the time. A more deplorable sign of demoralization is the prevalence of family discord and loss of interest in a higher life. The aggressions of the State have stimulated selfishness, bad temper and incipient rebellion. The children disobey their parents, the younger brothers reject the primacy of the older, and money earned elsewhere is kept from the family treasury. With the decadence of family life there is a decadence of religious life. Although the peasants are nominally orthodox, they care nothing for religion. Even the clergy confirm the fact that they are becoming more and more indifferent to the church. What they seek is not to penetrate the mysteries of life, but to obliterate consciousness of them. "Under these circumstances," says Tolstoi, alluding to the economic and mental decadence, "the craving for forgetfulness is natural, and accordingly spirits and tobacco are being consumed in ever greater and greater quantities." He adds that "even quite young boys drink and smoke."

Since the loss of freedom due to the seizure of property is the same in the last analysis as that due to an abridgement of the right to think and act, the evils of ecclesiastical and bureaucratic despotism do not differ from those of excessive taxation. Nevertheless, they receive separate attention at the hands of Tolstoi. As a proof of the blight of a church that the peasants have no part in directing, he points to the profound and beneficent change wrought the moment they fall in with a sect of dissenters. "Their spirits at once rise," he says, "and at the same time the foundation of their material prosperity is laid." A blight of the same kind can be traced to the attempt of the state to play the paternal role. "Nominally," says Tolstoi again, "there exist for the peasants special laws with regard to the possession and division of land, to inheritance, and to all the duties connected with it, but in reality there is a kind of hodge-podge of regulations, explanation, customary laws, decrees of courts of cassation and so on, which naturally makes the peasants feel their absolute dependence on the will of innumerable officials." Knowing that they are powerless to resist the Government, which is constantly flogging them for disobedience or stupidity, they comply as best they can with the thousand rules and regulations made for them. Seldom do they think of acting upon their own responsibility. Thus they lose the power of private initiative. What the impoverishment of taxation has not done to ruin them is left to ecclesiastical and bureaucratic despotism to complete.

It is curious to note that Tolstoi's remedy for these evils is the one that Herbert Spencer himself might have suggested. With one stroke he dismisses the prescriptions that the social reformer in the United States as well as in Russia attaches so much importance to. It is not, in his opinion, "the ministry of agriculture, with all its contrivances," that will reclaim the peasants, nor is it "exhibitions nor schools for rural economy," nor that "unfailing" remedy "for all evils," *i.e.*, parish schools. The thing they need is freedom. "It is necessary," says Tolstoi, "to give them religious liberty, to subject them to common instead of special laws—the will of rural officials; it is necessary to give them liberty of education, liberty of reading, liberty of moving about, and, above all, to remove the power to torture brutally by flogging grown-up people simply because they belong to the peasant class." But to give them such freedom means to deliver them not only from excessive taxation but from vexatious rules and regulations. It is to apply to them the same remedy that must be applied in the United States to save the American people, now so heavily taxed and so oppressed by countless laws, from the same social decadence that afflicts Russia.

The Coal Industry as an Index of National Progress.

A writer in the "Coal Guardian," treating of the matter named in the heading, says:

The development of our national trade and industries and that of other foreign countries who come into active competition with us has been dealt with from various points of view. The great advance which Germany has made in recent years has given rise to alarmist conceptions of our future, and the fact that a country which is so far behind us in the extensiveness of trade dealings has made strenuous endeavors to overtake the ground lying between us has caused many to conclude that England's sun is setting. No doubt this state of affairs can be easily proved by a skillful manipulation of figures, but there are numerous indications in the industrial history of this and other countries, analogies of decadence and transference of trade, which have gone on ever since industrial communities existed, which inspires one with the belief that they are the natural and necessary corollary of the existing social and economic conditions, and that we are little worse in these respects than our neighbors. But such temporary and transient phases must not be accepted as indications of the character of the whole of national industry. The presence of local disease does not imply an unsound constitution; rather does it prove its vigor and ability to withstand periodic incursions. But it should remind us that the body politic needs as much careful supervision as the body physical, and that the greatest menace to its stability and continuance comes chiefly from within, and not from without. The object of the present article is to refer to the method of testing in a new manner the trend of our national industrial life in comparison with that of other countries. The production and use of coal lie at the bottom of manufacturing supremacy—a condition of things which has obtained since the introduction and application of steam power to all departments of industry. Few employments exist at the present time which do not demand the use of coal for producing the power required.

In some departments of labor, such as in the production of materials of luxury, the manufacturer survives, but for all practical purposes the employment of coal is the basis of production. Considering, therefore, that this is now the case, the consumption of coal in different countries may be regarded as a fair indication of their progress and prosperity. Up to the present time Great Britain has held the supremacy in coal production, and even now only one country in the world is in any degree threatening that position. This is, of course, the United States, although her output is still some distance behind our own. That it will in a few years surpass it we can scarcely doubt, but that it will develop an export trade on the lines of ours we do not expect. It has too many uses for the mineral in its own internal affairs to allow of any very large shipments to foreign countries to take place, even if any profitable markets were available. The geographical position of Great Britain enables it to employ this mineral commodity as a convenient form of exchange. If we could use the figures representing the output of coal as indicative of commercial and industrial supremacy, then would Great Britain's position be unquestionable. But although every ton of coal worked, whether it is used at home or shipped to some foreign port, stands for labor employed and wages earned and revenue received, it is so much more important as a medium to creating additional value that we must look rather to consumption than to actual production.

Coal is, in fact, merely an item in combination with other factors of making valueless things valuable and unmarketable commodities marketable. Viewed in this light, therefore, we are supplying Germany, France, Belgium, Russia with the means of producing those articles which meet our own in different markets of the world. Germany and Belgium each has a coal export trade of its own, it is true, but it cannot be placed in the same category as British coal, much of which is good steam coal, and coal having high qualities for use in smelting, etc. Although, therefore, we do not derive the entire benefit from the

coal we produce, by it we may be said to participate to an enormous extent in the world's trade.

At the outset of this inquiry it may be desirable to notice the proportions of various countries in the world's coal production during the past few decades. In the matter of absolute production, of course, Great Britain stands easily first, although America is quickly approaching our output. This country, however, has little bearing on the phase of the subject with which we are dealing. Its potentialities, so far as outside trade is concerned, are more prospective than present, and from this point of view reference will be made to them later.

Although the quantity of coal raised in different countries is not an altogether reliable indication of the progress of trade in those countries, it has naturally an important bearing upon it. Figures are therefore appended below showing the production at various periods in the principal manufacturing countries of Europe—that is, of those countries whose commodities come most in competition with ours (1 = 1,000 tons):

	1860.	1865.	1870.	1875.
Great Britain.	85,396	99,731	112,241.5	133,990
Germany.....	15,080	28,246	26,398	37,436.4
France.....	8,309.6	11,840	13,300	16,956.8
Belgium.....	9,610	11,841	13,697	15,011
Totals....	118,395.6	151,658	165,636.5	203,394.2
	1880.	1885.	1890.	1895.
Great Britain.	149,182.4	161,917	184,538.3	192,687
Germany.....	46,973.5	58,320.4	70,237.8	79,169.3
France.....	19,361.5	19,510.5	26,083	27,801.3
Belgium.....	16,886.7	17,437.6	20,366	20,457.6
Totals....	232,404.1	257,185.5	301,225.1	320,115.2

Favorable as this table appears to Great Britain, it will be observed on closer scrutiny that Germany has made very great strides in her output between 1860 and 1895, while, although our own raisings have shown great advances, it has been at a decreasing ratio, and this is the contention of those who declare that Great Britain is slowly but surely being ousted from different markets. Of the totals of production given above, the following table shows the percentage proportion in which each country dealt with has contributed, and the comparative and relative position of each:

	1860.	1865.	1870.	1875.	1880.	1885.	1890.	1895.
Great Britain...	71.9	65.4	67.4	65.6	64.0	62.7	61.0	59.9
Germany.....	12.7	18.7	15.8	18.3	20.1	22.5	23.2	24.6
France.....	7.0	7.7	7.9	8.3	8.3	7.5	8.6	8.6
Belgium.....	8.0	7.7	8.2	7.5	7.2	6.7	6.7	6.3

The position of Great Britain, therefore, as a producer of the source of steam power has, in relation to the other countries named, altered from 71.9 to 59.9 per cent., while Germany has contributed to the necessary power of the four nations 11.9 per cent. more than she did 35 years ago. In the cases of France and Belgium, the former has exhibited an almost stationary condition; the latter an actual decline between the two periods. There are, of course, modifying factors in each of the three latter countries. Germany imports largely, and at the same time exports considerably; France imports over 10,000,000 tons of foreign coal per annum and exports none, and this would naturally affect her consumption favorably; while Belgium, although to a small extent increasing her output, shows a like inclination in regard to imports and exports, the former running to nearly 2,000,000 and the latter to over 5,000,000 tons per annum. It might, therefore, be argued, and reasonably so, that production is no criterion of consumption, which must be the testing standard of the position of different manufacturing countries. Before referring to the United States as a coal producing and consuming country, the consumptive capacity of the European countries will be dealt with. The following table sets out the absolute tonnage of coal absorbed by each country, for all purposes, in thousands of tons:

	1860.	1870.	1880.	1890.	1895.
Great Britain.	75,000	98,000	128,000	153,000	159,045 6
Germany.....	15,000	30,000	52,000	64,533.7	72,094.1
France.....	14,300	18,800	28,800	34,600.	38,062.4
Belgium.....	6,100	10,500	11,500	16,552	16,818.4
Totals....	110,400	157,300	220,300	268,685.7	286,020.5

Some of these figures, especially for the earlier periods, have been extracted from an authority not usually regarded as very reliable, but for the foreign countries it has been difficult to obtain the quantities consumed. The variations that occur in the calculations are common in extent to each country for the years 1860 and 1870, and will not affect the conclusions to be drawn from the table. So far as consumption is concerned, therefore, Great Britain, in the aggregate, is still far ahead of Germany, its greatest rival, but the increase which has occurred in coal consumption in the latter country will indicate in a general and comprehensive manner the way in which she is threatening our industry in various directions. Since it is in manufactures that this advance of coal consumption has taken place, such a condition of things as this table indicates is likely to make the Britisher extremely complacent, but it undoubtedly carries with it a serious warning, because the consumption of coal in two such countries as Germany and Great Britain is the pulse of national industry, and discloses the movement which is being made and in which direction. This, however, will be dealt with in more detail later. At this juncture the following table will probably bring home more clearly the relation in which we stand to the Continental countries dealt with. The figures represent the percentage proportion which is claimed by each country of the totals in the preceding table:

	1860.	1870.	1880.	1890.	1895.
Great Britain....	67.9	62.3	58.1	57.3	55.6
Germany.....	13.5	19.0	23.6	24.0	25.2
France.....	12.9	11.9	13.0	12.8	13.5
Belgium.....	5.5	6.6	5.2	6.1	5.8

It is practically a confirmation of the conclusions which might have been drawn from the table showing the coal output given above, and indicates, perhaps, more clearly than anything else could do the effect which German competition has upon the coal industry of this country. It is a fallacy to be satisfied with big totals is the lesson here; they are deceptive and induce delusions. France and Belgium are negligible quantities so far as the supremacy of our national industry is concerned, and although a considerable drop is visible in the proportion of coal consumed by Great Britain between 1860 and 1895, the figures uphold the fact that, taken as a whole, our country is the first and foremost manufacturing country in the world. There have been decadent industries and there are still in every country, but, as Sir Robert Giffen pointed out long ago, what we lose in one direction we gain in another, and the account is fairly well balanced. Between 1860 and 1895, however, there is this unpleasant fact to face, that we have now 12.3 per cent. less of the potential power distributed between Germany, France, Belgium and Great Britain than we had then, and, according to the figures, that 12 per cent. has gone to Germany alone. When further inquiry is made into the subject, however, it may be that this loss will be minimized and proved to be more apparent than real.

When we come to deal with each country separately the results are somewhat more startling. The comparative progress of coal consumption of these countries was as follows:

	Percentage Increase of—			
	1880 over 1870.	1885 over 1880.	1890 over 1885.	1895 over 1890.
Great Britain..	30.0	4.9	10 7	3.8
Germany.....	73.0	22.9	25.8	42.7
France.....	53.0	2.7	23.9	10.0
Belgium.....	9.5	7.9	12 7	1.6

According to this table the only country which has been making any continuous progress has been Germany, while the consumption of coal in Great Britain has relatively showed considerable decline, although in absolute quantity advance has been made, but on a much smaller scale than in the case of Germany.

Adding now the factor of the United States to our first table dealing with production, we shall get an idea of the increasing importance of this country in the manufacturing world, and the potential force it will exert in the future. It will be sufficient if we limit our horizon to the year 1870, and deal with the subsequent decades. We shall also disregard France and Belgium in this instance (1 = 1,000 tons):

	1870.	1880.	1890.	1895.
Great Britain...	112,241.5	149,182.4	184,538.3	192,687.0
Germany.....	26,398.0	46,973.5	70,237.8	79,169.3
United States...	29,940.6	66,813.0	141,590.0	169,013.9
Totals.....	168,580.1	262,968.9	396,366.1	440,870.2

The coming preponderance of American manufacturing power, not necessarily an external trade, is clearly foreshadowed in the above table, and although Great Britain is still in the first place in the matter of production, the United States is following close on her heels. The proportions of each country in the above totals are as follows:

	1870.	1880.	1890.	1895.
Great Britain..	66.5	56.7	46.5	43.7
Germany.....	15.6	17.8	17.7	17.9
United States..	17.7	25.4	35.7	36.0

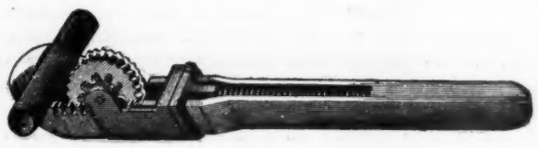
Both Great Britain and Germany have apparently suffered at the expense of the United States, and while the former has receded from its position very considerably, the latter has been enabled to make a slight advance. In the matter of coal consumption, however, the United States is already ahead of all countries. Of course, little coal is exported from the States, so that practically the whole of the raisings is consumed in the country itself for manufacturing and other purposes. Compared with Great Britain and Germany, the consumption at certain periods has been as under (1 = 1,000 tons):

	1880.	1890.	1895.
Great Britain...	131,658.8	153,010.3	159,045.6
Germany.....	52,000.0	64,533.7	72,094.1
United States (long tons)	65,597.0	142,633.6	166,684.6

The progress of the United States indicated by this table is remarkable, and unless further analysis proves otherwise, the United States is already at the head of the nations as a manufacturing people, though as an exporting country Great Britain, of course, maintains its supremacy, measured by its potential capacity in coal.

The Browning Double-Gripping Pipe Wrench.

The Bonney Vise and Tool Works, of Philadelphia, Pa., are placing before the trade a double-gripping pipe wrench, which is shown in the illustration.



The device consists of an extended jaw of malleable cast iron, so formed as to present a channeled center, in which the working parts are located. The jaw proper is solid and toothed in the usual manner. The binding or gripping of pipe is effected by means of a movable or sliding jaw, controlled by a spring and having two rollers, each with angular teeth set at right and left angles and an outer cogged or locking face. These rollers work independently of each other, to adapt themselves to the surface of the pipe to be gripped. The outer edges of the main or extended jaw are cogged or racked, so that when the rollers are bearing on pipe there is a counter force exerted by the cogged or locking faces of the rollers against the racking on the main jaw, thus producing a double grip and relieving the axle of the rollers from all strain. The wrench is quick acting and may be operated by one hand.

The tool is made in sizes taking from ½-inch wire to 2-inch pipe, and is capable of withstanding the roughest handling.

Tests of Frozen Cement Mortar.

Last week we reprinted, from "Engineering Record," a compilation from a paper prepared by Mr. Charles H. Godfrey for the Institution of Civil Engineers, respecting the effect of frost on Portland cement. The following matter, printed also in "Engineering Record" for the last week in December, respecting a series of tests of frozen cement mortar, made by Mr. Arthur G. Fogg, of Roslindale, Mass., will be of interest. There is possibly an impression that mortar which has been exposed to alternate freezings and thawings ultimately becomes valueless, and Mr. Fogg's observations as summarized in his inferences in each set of tests indicate that this view is not well founded, as in some cases mortar is strengthened by freezing.

Series I. of the tests had for its object to see if Portland cement mortar will gain strength in air while in a frozen condition. The tests were conducted in February, 1895. Alsen cement mortar was mixed one to one and frozen in air in a refrigerator designed for the purpose. The figures given are the averages of five briquettes each, broken after being thawed out; *i. e.*, after keeping them in water one hour at 70° F. temperature.

Briquettes seven days at 50°, not frozen, showed a tensile strength of 290 pounds per square inch; seven days at 50°, then frozen seven days at 25°, 224 pounds per square inch; seven days at 50°, then frozen fourteen days at 25°, 234 pounds per square inch. Briquettes exposed to a temperature of 25° as soon as mixed gave these results: Kept seven days, 110 pounds per square inch; kept fourteen days, 144 pounds per square inch; kept fourteen days, then fourteen days at 60°, 270 pounds per square inch.

Inferences.—This series of tests shows that Portland cement mortar will gain strength when exposed to freezing temperatures whether before or after setting.

The following tests were made in January, 1896, to substantiate the foregoing: Five briquettes were made, using Giant cement mortar mixed one to one. Three of them were immediately exposed to zero F. and kept frozen several days, left out doors from January 4 to April 4, then broken, with the following results: 490, 485 and 425 pounds per square inch. Two of them were kept dry indoors at 50° F. during the same period for comparison, breaking at 220 and 275 pounds per square inch.

Series II. was undertaken January 9, 1896, with the object of ascertaing if alternate freezing and thawing in air will injure Portland cement mortar. Giant cement mortar mixed one to one at 50° was placed outdoors at 20° as soon as mixed and left out for 24 hours. It was then taken in to a temperature of 50° and left 24 hours, then frozen again 24 hours. This operation was repeated several times, then left outdoors until March 6 and broken, with the following results: 120, 130 and 125 pounds per square inch (representing three briquettes). Three other briquettes were made at the same time and kept dry indoors at 50° during the same period for comparison. They broke at 260, 300 and 250 pounds per square inch.

To substantiate the foregoing, and to make the test more severe, two briquettes were made of Alsen cement mortar and mixed thin like grout, one to one, placed outdoors as soon as mixed at zero and left 24 hours, then taken in to 50° and left 24 hours, etc., being alternately frozen and thawed several times. They continued to set all the time without disintegrating.

Inferences.—This series shows that Portland cement mortar is not destroyed by alternate freezing and thawing in air, but that it sets slower than when the temperature is kept either above or below freezing during the test.

Series III. was conducted in January, 1896, the object being to ascertain at what rate Portland cement mortar will gain strength while in a frozen condition in air. Giant cement mortar was mixed one to one at 50°, exposed to freezing weather as soon as mixed, and thawed out just before breaking. Two briquettes kept frozen 24 hours showed a tensile strength of 25 pounds per square inch. Two frozen six days showed 90 and 60 pounds pounds per square inch; average, 75 pounds. Two frozen eight days showed 100 pounds each. Two frozen thirteen days showed 117 and 120 pounds per square inch; average, 120 pounds. Two frozen twenty-eight days showed 165 and 155 pounds per square inch; average, 160 pounds.

Comparable tests were made with briquettes kept dry indoors at 50° temperature. Two briquettes kept 24 hours showed tensile strength of 40 pounds per square inch each. Two kept six days showed 75 and 70 pounds per square inch; average 73 pounds. Two kept eight days showed 135 and 95 pounds per square inch, average 115 pounds. Two kept 13 days showed 140 and 145 pounds per square inch, average 143 pounds.

Inferences.—This series and Series I. indicate that freezing retards the setting of Portland cement mortar. Probably in time the frozen mortar would be as strong as the unfrozen. A long time test should be made.

Series IV. was conducted in February, 1895, with the object of ascertaining if Portland cement mortar is injured by freezing in ice or water, and if so, how near to freezing weather it is safe to use it. Alsen cement mortar made one cement to two sand was mixed at 50°, packed in salted ice and kept at about 25° until broken at the end of seven days.

Time between Mixing and Packing in Ice.	Averages of 3 Briquettes each, Broken in a Frozen State.	Averages of 2 Briquettes each, Broken after Thawing.
0 minutes.	0 pounds per square inch.	0 pounds per square inch.
15 "	0 " "	0 " "
60 "	0 " "	0 " "
12 hours.	0 " "	0 " "
24 "	0 " "	0 " "
2 days.	95 " "	0 " "
3 "	192 " "	170 " "
4 "	230 " "	190 " "
5 "	252 " "	250 " "
6 "	312 " "	170 " "
Kept at 65°.	.....	230 " "

In tests made in January, 1896, Giant cement mortar one to one was mixed at 50°. Three briquettes were kept at 50° ten hours, then placed in water and exposed to zero temperature; kept frozen twenty-eight days. They were then thawed out and broken at 160, 170 and 160 pounds per square inch. Two briquettes were kept at 50° during the same period for comparison, and these broke at 170 and 175 pounds per square inch. This cement was very quick setting.

Inferences.—It is not safe to allow a cement mortar as slow setting as "Alsen" to freeze in less than four days after it has been placed, while a very quick setting mortar may freeze in twelve hours without injury, provided the mortar is kept frozen until set. According to practice, if salt is added to the water of mixture, the effects of freezing are lessened.

Series V. was undertaken in January, 1896, to see how Portland cement mortar acts when it is frozen and thawed out several times before it has had time to set very hard in water. The mortar was placed in water and exposed to freezing temperature 24 hours, then taken in to a temperature of 50° and kept 24 hours, then frozen again 24 hours, etc., alternately. Alsen cement was used, one of cement to one and a half of sand, mixed thin as used in practice, at 50°. Briquette held 24 hours before being frozen was completely disintegrated at the first thaw. That held two days before freezing had at the first thaw disintegrated about ¼ inch deep; at the second thaw had disintegrated slightly more and at the third thaw showed no change. That held three days before freezing showed at the first thaw the surface disintegrated and at the second thaw no change. That held four days before freezing showed at the first thaw no effects, and its condition was unchanged on the second thawing. Giant, very quick setting cement mortar mixed one to one at 50° and similarly tested showed as follows: Briquette held 12 hours before freezing, at first thaw surface disintegrated; at second thaw no change. That held 24 hours before freezing was not affected at the first thaw and showed no change on the second.

Inferences.—This test indicates that Portland cement mortar is injured more when it alternately freezes and thaws than when it remains frozen before it has set hard. The tensile strength of mortar when soft is not sufficient to resist the expansive force of ice. This series, like Series IV., indicates that Portland cement mortar should not be allowed to freeze before it has set hard, unless it is kept free from water and ice.

Series VI. was undertaken in January, 1896, to see how much strength Rosendale cement mortar will gain when in a frozen condition in air. Crescent cement mortar made one to one was mixed stiff. Two samples, frozen as soon as made, kept frozen four days and then thawed out, gave each a tensile strength of 60 pounds per square inch. Two briquettes kept at 50° four days for comparison gave 90 and 85 pounds per square inch, average 87 pounds. Five briquettes, frozen as soon as mixed and kept outdoors in the changeable weather three months, gave 350, 370, 385, 385 and 370 pounds per square inch; average 370 pounds. Five briquettes, kept at a constant temperature of 50° dry during the same period of three months for comparison, gave 170, 175, 145, 160 and 170 pounds; average 165 pounds.

Crescent cement mortar mixed one to one, thin as used in practice, showed: Three briquettes exposed to 25° as soon as made and kept frozen 12 hours, then taken in to 50° and kept 12 hours, then frozen again several times alternately during two months; 205, 205 and 195 pounds per square inch; average 202 pounds. Three briquettes kept at 50° in dry air during the same period of two months, for comparison: 135, 145 and 165 pounds per square inch; average 148 pounds.

Inferences.—Rosendale cement mortar is not injured by freezing in air. It is in fact strengthened (a conclusion reached by other experimenters).

Series VII. was also conducted in January, 1896, with a dual object. First, it was endeavored to learn if Rosendale cement mortar is injured by being frozen in water or ice. Series IV. was repeated with Rosendale cement (Crescent) mortar, mixed one cement to two sand, stiff, and at the end of seven days they were entirely disintegrated. Five briquettes were mixed one to one at 50°, kept 10 hours and then placed in water and frozen at zero. They were kept frozen one month, and in thawing them out they all crumbled up.

The second object was to see how long Rosendale cement mortar has to set before it can stand freezing in water. Eight briquettes were allowed to set for varying lengths of time before freezing. Briquette 1 set 24 hours before freezing at a temperature of 25°; briquette 2 set 36 hours, froze at 25°; briquette 3 set three days, froze at 27°; briquette 4 set five days, froze at 25°; briquette 5 set 15 days, froze at 22°, and briquette 6 set 21 days and froze at 15°. All these briquettes were thawed out in 24 hours and all crumbled. Briquette 7 set 28 days, froze at 21°, was thawed out at 24 and 48 hours and cracked. Briquette 8 set six weeks, froze at 25°, was thawed out at 24, 48, 72, etc., hours and was not affected.

Inferences.—When Rosendale mortar is mixed very stiff it is not safe to let it freeze in water in less than six weeks, and as mixed in practice it probably is not safe in less than two months.

Obituary Note.—Mr. Ronald T. McDonald.

Electricity in its issue for December 28 prints the following obituary mention of the late Mr. Ronald T. McDonald:

We regret to have to announce the death of Mr. Ronald T. McDonald, which occurred suddenly at Dallas, Texas, on the morning of the 24th inst., occasioned, according to the latest advices, by pneumonia. Mr. McDonald was born in 1849, and after serving in the Civil War engaged in mercantile pursuits until 1882, when he entered the electrical field. For a number of years past Mr. McDonald had been a well-known figure in the electrical industry, and had ever shown himself a man of indomitable energy and full of resources. His one aim in life was to succeed in everything he undertook, apparently caring little in what manner the results were brought about so long as the desired goal was reached. Many curious incidents are related of Mr. McDonald's experiences which go to show the pluck and resources of his nature when called forth in times of emergency.

One of his old-time friends relates the following incident: When Mr. McDonald was in the drygoods business in Michigan, before his entrance into the electrical field, a patron of his in a country town owed him quite a large bill and Mr. McDonald went himself to collect it. On his arrival he discovered to his consternation that the man's place was closed and that the man himself could not be found, but it was rumored that he was getting papers ready for an assignment. Mr. McDonald hastened to procure an attachment on the goods in the store; the sheriff stated he could not make the attachment as the store was locked and there was no way of getting in. The Sheriff added that were the doors open he could readily make the attachment in time to secure Mr. McDonald's claim. Quick as a flash the latter seized a plow that was standing in front of an adjacent store, and using it as a battering ram broke in the door. The Sheriff then walked in and made the attachment and Mr. McDonald saved his claim.

After a successful commercial experience Mr. McDonald started in the electrical business in 1882 in connection with Mr. Charles D. Jenney, now of Indianapolis, and his father. They manufactured arc light machines for a number of years, disposing of them in large numbers to municipalities, at which work Mr. McDonald was an adept. This corporation was known as the Fort Wayne Jenney Electric Light Company, the controlling interest being afterwards purchased by Mr. Coffin for the Thomson-Houston Electric Company. For some time thereafter Mr. McDonald and Mr. Coffin were warm personal friends and conducted together many operations of considerable magnitude. A short time after the formation of the General Electric Company Mr. McDonald became dissatisfied with the manner in which his Company was being handled, and organized the present Fort Wayne Electric Corporation, of which up to his death he was President. By exceedingly bright manœuvres he succeeded in getting possession not only of the factory of the old Fort Wayne Company, but of practically all of its assets as well, much to the disgust of the General Electric Company.

During the legal difficulties which arose over the acquisition of the asset of the old Fort Wayne Company, Mr. McDonald leased the Wenstrom factory in Baltimore and used it as a club to bring the General Electric Company to terms. In addition to his interests in the Fort Wayne Electric Corporation, Mr. McDonald was a large owner in the New Orleans Edison Electric Light Company, as well as in the New Orleans Artificial Ice Plant. He was also a stockholder in the Hoffman House, New York, a large owner, with Mr. Samuel Insull of Chicago, in the Fort Wayne Lamp Company, and other enterprises.

Mr. McDonald was a man of untiring energy, one of the greatest "hustlers" in the electrical industry, and withal a pleasant and agreeable companion. By his death the industry loses a man who made his mark on the pages of its history, even if the mark was sometimes blurred by methods that subjected him to severe criticism. He was a resident of Fort Wayne, Ind., where he leaves a devoted family to mourn his untimely death.

THE Directors of the Ann Arbor (Mich.) Gas Company are arranging for a revision of the rate schedule. It is also proposed to greatly enlarge the manufacturing capacity of the plant.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

COLONEL W. B. SELLERS has resigned the Secretaryship of the Covington (Ky.) Gas Light Company. Mr. W. B. George has been named to succeed him. We regret to have to say that the resignation of Col. Sellers was caused by ill health.

AT a recent meeting of the shareholders of the Buffalo (N. Y.) City Gas Company the resignation of Mr. Emerson McMillin was accepted. Mr. A. C. Humphreys was chosen to replace him.

THE Electric Gas Stove Company, of Detroit, Mich., has sold its properties and plant to the Ideal Manufacturing Company, of Detroit. The latter proposes to go on with the business on an extended scale.

MR. DUNCAN JONES, Secretary of the New Orleans (La.) Gas Light Company, informs the shareholders that a dividend of $2.50 per share is payable on and after the 15th inst.

MR. FELIX C. LORENZEN, Secretary of the Jefferson City (La.) Gas Light Company, has, by authority of the Board of Directors, issued the following circular letter to the shareholders: "A meeting of the stockholders of this Company is hereby convened to be held in the Company's office, on Tuesday, the 17th day of January, 1899, from 2 to 4 P.M., for the purpose of considering the subject of liquidation, in view of the approaching expiration of the charter on the 9th day of March, 1899, and to consider and act on the expediency of passing then and there a resolution to dissolve the corporation; and in either event to elect three liquidators to take charge immediately when the resolution passes or upon the expiration of the charter; the whole in accordance with Articles 10 and 11 of the charter of this Company."

A CORRESPONDENT at Alexandria, Va., writing under date of December 31st, says: "In common with yourselves (as per your reference in the JOURNAL of December 26th), several Alexandrians have been much amused over the proposition submitted by the Standard Gas Company of America, whereby the latter asked permission to operate the local municipal gas works. In the belief that your readers might like to scan the American Company's 'good thing' in its entirety, I herewith submit the same to you:

"'To the Honorable City Council of the City of Alexandria, Va.: The Standard Gas Company of America, having its headquarters in the Bourse Building, Philadelphia, Pa., desires to submit to your honorable body the proposition for furnishing gas to the city of Alexandria, of equal candle power to that now used by it and its consumers, the purpose of the Company being simply to manufacture said gas and deliver it to the city, leaving the management and control of the gas works and the supply of gas and its distribution entirely within the province of the city and the officers as now constituted, so that there need be no change or interference by said Company in the conduct or management of the gas office, and leaving the city to dispose of the gas so furnished at such price as it may deem right and proper. With that object in view the Company submits for your consideration and approval the following propositions, to wit:

"'1st. That it will furnish and deliver to the holder a coal gas of equal candle power to that now used by the city for the price or sum of 60 cents per 1,000 cubic feet, measurement to be taken by meter measure, as gas passes from the holder on to the city.

"'2d. To carry out the purposes of this proposition the Company shall have the use and occupancy of the plant now in operation for the manufacture of gas and for such improvements as may be necessary. And any and all such improvements as may be made shall be so made at the expense of the Company, and at the termination of this contract shall revert to and become the property of the city of Alexandria.

"3d. In the event of a contract being made in pursuance of this proposition it shall continue and remain in force for the period of 25 years from the date thereof, and the Company will enter into a good and sufficient bond for the performance of its contract, and be in readiness to furnish gas in 90 days from the acceptance of this proposition.

"'4th. That the payment to the Company for the said gas manufactured and delivered to the city shall be made every three months.' The proposition was signed by Mr. James R. Flanigen, as attorney for the Company; but that it will ever be accepted by and become binding upon the city is not at all likely."

WORK on the remodeling of the gas plant at Somerville, N. J., is being pushed with vigor.

THE dominant interest in the gas supply of Paterson, N. J., is undoubtedly in the market for the Edison Electric Illuminating Company of that city. The bid price for the stock, which earns something like 4 per cent. per annum, is par. The owners, however, consider 110 to be nearer the real mark.

AT a meeting of the President and his Secretaries and other members of the Cabinet (held December 23d) the following orders were passed for issuance to the officers in command of Cuba, Porto Rico and the Philippines: "Until otherwise ordered, no grants or concessions of public or corporate rights or franchises for the construction of public or quasi-public works, such as railroads, tramways, telegraph and telephone lines, water works, gas works, electric light lines, etc., shall be made by any municipal or other local governmental authority, or body in Cuba, Porto Rico or the Philippines, except upon the approval of the Major-General commanding the military forces at those places who shall, before approving any such grant or concession, be so especially authorized by the Secretary of War."

MR. A. M. SUTHERLAND, who is to oversee and carry out the proposed enlargement of the plant of the Green Bay (Wis.) Gas and Electric Light Company, says that work for such account will be well underway by the 15th inst.

MR. GEORGE F. GOODNO has been appointed Superintendent of the Waukegan (Ills.) Gas Light and Fuel Company. The new plant of the Company was fixed up in time for the benefit and pleasure of the shopkeepers and purchasers of Waukegan just before the Christmas holidays.

MESSRS. BAXTER & LYNN, of Detroit, are said to be the parties who are negotiating for the purchase of the plant and franchises of the Portsmouth (Ohio) Gas Company.

MR. GEORGE B. CHANDLER has been elected President of the Manchester (N. H.) Gas Light Company.

A SAN FRANCISCO news agency reported on the morning of December 28th that an explosion of a holder (which explosion occurred early the night before), belonging to the Fresno (Cal.) Gas and Electric Light Company, would "plunge the city in darkness for a week or more." Something did happen the holder on the date named, but Fresno was supplied with gas the next night just the same.

THE authorities of New Haven, Conn.—especially Lamp Inspector Hopkins—are positive in their expressions of satisfaction over the worth of the Welsbach lamp as a street illuminator.

"OBSERVER'S" latest budget is appended: "During the past few months there have been shown, in Boston and neighboring towns, several of the various forms of incandescent mantles, heated by gasoline, forced to the burner by air pressure from a tank. The 'Washington light' was extensively advertised in Boston, and considerable money changed hands in stock operations; but little is seen of it now, although other forms of the device are still in the field. The objections to these burners which have been so far developed are: The heat, the care required to start and to operate them, the expense, and the danger of fire. They generate an intense heat; each lamp has to be started by heating the burner with alcohol; a pressure of 40 pounds or thereabouts has to be kept on the tank; mantles subjected to the blast pressure do not last over four nights usually; and, finally, several have caught fire, resulting in considerable black smoke, but no great fire loss. As the price charged for service is not much below that charged for electric arc service, it apparently will be a no more dangerous competitor. The famous subway case was closed in Boston last week and had the record of being the longest trial in the history of the Massachusetts courts. The jury gave a verdict against the Boston Light Company of $3,000 in the case of Wolf Koplan. There are some 90 other cases for liability, so it is probable the case will go to the Supreme Court, and will be fought as long as possible. The jury found for the defendants, the Metropolitan Construction Company, who excavated the cavity wherein the explosion occurred, and the West End Railroad Company, which, presumably by a spark from its car wheels, ignited the mixture. There

was a vast amount of testimony presented as to gas leaks and the system of caring for them. Perhaps the only novel feature was the testimony introduced to show that it was possible to produce an explosive gas from the insulating compound used by the Edison Company in its tubes. The ground taken by the Gas Company was that such gas was produced by a short circuit in the Edison conduits, and fired by its own electricity. In support of this theory cases were cited where manholes had been blown in the air, and other explosions had occurred in exactly this manner in the streets of Boston. Samples of gas made were shown, and expert testimony given, that such an explosion could have taken place under the conditions existing. The jury, however, as stated, found the Gas Company liable, which hardly seems in accord with the facts presented to them."

IT is quite likely that the election of Mr. George W. Morris (now President of the Louisville Gas Light Company) to the Presidency of the Mutual Life Insurance Company, of Kentucky, means that he will resign the first named position. Our informant adds that if coming events cast their shadows before, the penumbra in the Louisville gas shadow indicates that Mr. Udolpho Snead will succeed Mr. Morris.

THE proprietors of the Plymouth (Mass.) Electric Light Company have applied to the Board of Gas and Electric Light Commissioners for the right to issue stock to the amount of $70,000. The hearing is set for 10 A.M. of the 12th inst.

A CORRESPONDENT in Portland, Me., writing under date of the 2d inst., says: "Another meeting of the first mortgage bondholders of the Bath (Me.) Gas and Electric Company was held at the office of Mr. Galen C. Moses the afternoon of December 27, at which a new proposition was submitted. It was put in by Mr. Joseph M. Trott, representing the Bath Light and Power Company, of which concern Mr. Edward W. Hyde is President, and Mr. H. H. McCarty is Treasurer. The proposition was that the new Company shall exchange the present bonds for similar ones, paying 5 per cent. for 20 years, the Light and Power Company to take over and operate the property of the Gas and Electric Company. No definite action could be taken, however, as the holders of the second mortgage bonds, and the general creditors as well, have quite a voice in the matter. The meeting adjourned, subject to the call of the Clerk, Mr. George E. Hughes."

THE Athol (Mass.) Gas and Electric Company, so far as its proprietorship is concerned, has experienced another internal revolution, which disturbance was occasioned by the failure of Mr. Galen C. Moses, of Bath, Me. The present standing of the concern appears that its control is vested in residents of Athol, headed by Mr. George D. Bates. The shake up was not sufficient to unseat Mr. F. R. Davis, of Athol, who will continue to act as Secretary and Treasurer of the corporation.

A CORRESPONDENT in Montreal, Can., writing under date of January 3d, says: "The Canadian Court of Appeals has declared judgment in the case of the Montreal Gas Company (appellants), defendants in the Court below, and Thomas Ebenezer Vasey (respondent), plaintiff in the Court below, and the counter appeal of Vasey against the Company. The case originally arose out of a contract entered into between Vasey and the Company, December 15th, 1886, for the sale to the former of all the liquor manufactured at both its works, for which Vasey bound himself to pay $4.86 per ton of sulphate of ammonia manufactured by him from the liquor supplied by the Company, as long as the net price in London, England, exceeded £9 10s. The contract was for five years. Some days after the signing of the contract Mr. Jesse Joseph, the then President of the Gas Company, wrote Mr. Vasey, stating that if the Company was satisfied with him, at the end of the contract, as a customer, it would favorably consider an application from him for a renewal of the contract. At the expiration of the contract, Mr. Vasey sued for $32,000 damages, because the liquor supplied him had been of a strength inferior to that agreed upon; that a lot of it had gone to waste; that the Company had not fuifilled its agreement regarding the supply of its spent oxide of iron; and that, moreover, he had lost $20,000 by the non-renewal of the contract. Judge Mathieu, in the lower Court, had allowed Mr. Vasey $15,000 damages, of which sum $10,000 was assessed for non-renewal of contract. The Court of Appeal concurred in this judgment, save Chief Justice Lacoste, who dissented respecting the $10,000 item, on the ground that the President's letter was not binding on the Company, in that it had not been indorsed by the Directors. He also dissented from his colleagues as to the rate of interest which has been running for some six years. The majority of the Court allowed interest from the date of institution of the suit. The Company's claim of $1,686.29, for balance of price of sulphate of ammonia manufactured by Vasey during the contract was not allowed."

THE announcement is made by the proprietors of the Essex and Hudson Gas Company, of New Jersey, that hereafter the gross rate in their Newark district shall be $1.20 per 1,000 cubic feet, less 10 cents per 1,000 for prompt payment—within three days; in the Montclair district the price is to be $1.50 per 1,000—a cut of 50 cents; and in the Summit territory the rate is placed at $1.75—a concession also amounting to 50 cents per 1,000. President Shanley evidently means to keep up with the procession, at least so far as the gas rates are concerned; and it is to be hoped that he will finally and speedily convince his associates that the amended rate in the Montclair-Bloomfield territory is susceptible of a further reduction.

ACCORDING to the report of the City Gas Inspector of Chicago (Mr. Maurice O'Connor), the number of gas lamps in use in that city, January 1, 1899, was 28,245; the gasoline lamps in service numbered 10,106. At the like date in 1898 the figures were: Gas lamps, 33,042; gasoline lamps, 10,224. This statement shows a decrease of 4,797 gas and of 118 gasoline lamps during the twelvemonth, which decreases are chargeable "mainly to the account of the installation of electric lights by the city, and also to keep within the appropriation made for the gas inspection department."

Contractor's Mistakes in Estimating.

Engineering News says that a contractor's mistakes in estimating on public contracts are not sufficient to annul the contract in a court of equity, according to the U. S. Circuit Court of Appeals. This is set forth in a lengthy opinion by Judge Wallace, in "The Moffet, Hodgkins & Clarke Co., appellee, vs. the City of Rochester, N. Y., appellant." In January, 1893, the Company named refused to enter into a contract to construct a pipe line for the city of Rochester for the sum named in its bid, $857,552, alleging that it had made two mistakes in its estimates. There was also another reason alleged, but as this has been given no standing in the case it need not be considered. One of the mistakes alleged by the Company was the insertion of 50 instead of 70 cents per cubic yard for earth excavation, which, Judge Wallace states, is established by the evidence as a clerical error. The sum involved here is $36,800. The other alleged mistake was the insertion of $1.50 instead of $15 per cubic yard for tunnel excavation. On this claim Judge Wallace says the evidence indicates that the contractor omitted "to take into consideration certain features of the work," which "was not a mistake in any legal sense, but was a negligent omission arising from an inadequate calculation of the cost of the work," and affords no grounds for courts to allow contractors to recede from their engagements. The second alleged error amounted to $27,000, and the two errors, 63,800. The difference between the bid of the complainant and the next highest bid was $272,643. The suit was brought to prevent the city from proceeding to collect on the complainant's bond of $90,000, which bond, it will be noted, is about one-third the difference between the lowest and the next to the lowest bid. The lower court annulled the contract. The higher court reverses the decree and instructs the lower court to dismiss the bill. Judge Wallace states that had the complainant sought to reform the contract, increasing the price so as to include the amounts involved in the errors "it would have presented itself in an attitude which would at least have commanded the the sympathy of the court."

But this is small comfort, especially in view of the opinion already given regarding the inexcusableness of one of the alleged mistakes. He also states in another part of his decision that one of the reasons, not mentioned in this note, given by the Company for not executing the contract, gave the city grounds for believing that its chief motive was a desire to avoid the contract after finding its bid was so much lower than the others. The decision apparently permits the city to sue on the $90,000 bond of the complainants. The last opinion is published in the Rochester *Democrat and Chronicle* for Dec. 23, 1898. A review of the case to the close of 1897, including an abstract of the decision of the lower court, is given by Mr. Emil Kuichling, M.Am.Soc.C.E, Chief Engineer of the Rochester Water Works, in his annual report for 1897. Since the above was put in type we have received from Mr. Kuichling a carefully prepared review of the case, made under the direction of Mr. Adolph J. Rodenbeck, of Rochester, who prepared the case for argument while he was acting as Corporation Counsel. The following quotations are from this review:

The court here lays down the rule, enunciated for the first time by so high an authority, that for a mistake in the prices named in a proposal made in public competitive bidding, where there is no fraud or inequitable conduct on the other side, a bidder cannot be relieved from his proposal. * * * (The Corporation Counsel) insisted from the beginning that if the contention of the Company prevailed, there would be no security in public bidding, and that any bidder could easily be relieved from an unfavorable bid.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

CHAS. E. SANDERSON,
MANAGER.

MONDAY, JAN. 9, 1899.

The Market for Gas Securities.

Unreliability was the characteristic of the city gas share market last week. Consolidated sold down to 193 and up to 197, and towards the close to-day (Friday) a sale was made at 194½. The annual meeting of the Company will be held Monday, fortnight. It is thought that significant changes will be made in the executive management. Amsterdams are steady, and Standards are a trifle lower. Mutual is "300 bid;" the "Bank" has succeeded in getting in quite a bit of the stock at the figure quoted. We think the sellers made a mistake.

Brooklyn Union keeps constantly approaching nearer to its true value. Sales in it were made yesterday at 147. The opening to-day was 144½ to 145. Peoples, of Chicago, is 112½ bid. Bay State has had a relapse. This afternoon it sold at 6¼. Holders of this stock might do well to remember that the Company's charter is a peculiarly broad one. Baltimore Consolidated is 69 to 70. It will go higher. Detroit gas 5's are 95½ to 96.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

Jan. 9.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$37,730,000	100	194⅜	194¾
Central Union, Bonds, 5's.	3,000,000	1,000	105½	106½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	300	305
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co.	13,000,000	100	34	34½
Preferred	10,000,000	100	69	69½
Bonds, 5's	11,000,000	1,000	103¼	104
Northern Union, Bonds, 5's.	1,250,000	1,000	94½	95½
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	111	113
" 1st Con. 5's	1,500,000	..	107½	108½
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	137	140
Preferred	5,000,000	100	157	161
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	144½	145
" " Bonds (5's)	15 000,000	1,000	116¼	116½
Bay State	50,000,000	50	6⅝	6¾
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	..	..
" 1st Mtg. 5's	450,000	1,000	..	.
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	..	80
Buffalo City Gas Co.	5,500,000	100	15⅛	16
" " Bonds, 5's	5,250,000	1,000	93	93½
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	89	91
1st Mortgage	1,207,000	1,000	101	103½
Consumers, Jersey City	2,000,000	100	84	88
" Bonds	600,000	1,000	102	104
Cincinnati G. & C. Co.	8,500,000	100	203¾	203½
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	69	70
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	16	21
" Con. Mtg. 5's	380,000	1,000	75	80
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	95½	96
" Inc. 5's	31,000	100	..	..
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	75	80
" Bonds	2,000,000	..	88	
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jackson Gas Co	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	210	..
Lafayette Gas Co., Ind.	1,000,000	100	78	83
Bonds	1,000,000	1,000	90	91
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	52¼	52½
Preferred	2,500,000	100	96	96½
Bonds	10,000,000	1,000	107½	108
Madison Gas & Elec. Co.	400,000	100	..	..
" 1st Mtg. 6's	350,000	1,000	..	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	252	..
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	112	112¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	240	250
Rochester Gas & Elec. Co.	2,150,000	50	52	..
Preferred	2,150,000	50	103	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	88½	89
St. Paul Gas Light Co	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	..	..
Syracuse, N. Y.	1,750,000	100	103¾	104½
Bonds	1,612 000	1,000	85	80
Washington, D. C	2,600,000	20	250	255
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	85½	86
Bonds, 5's	3,380,500	.	101¾	102½
Wilmington, Del.	550,000		204	206

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO., DREXEL BUILDING, PHILA., PA., Dec. 21, 1898.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable on Jan. 14, 1899, to stockholders of record at the close of business Dec. 31, 1898. Checks will be mailed.

1229-3 EDWARD C. LEE, Treasurer.

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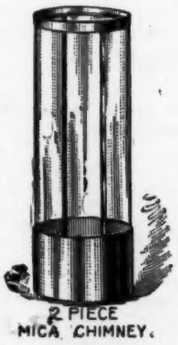

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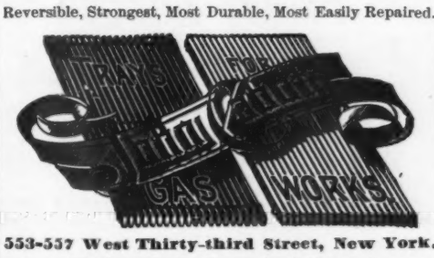

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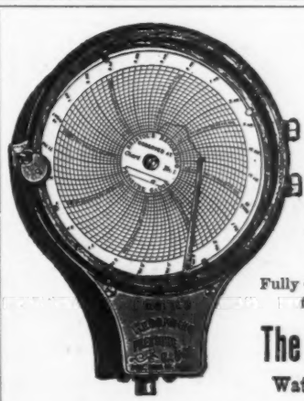

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—OF THE—

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MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

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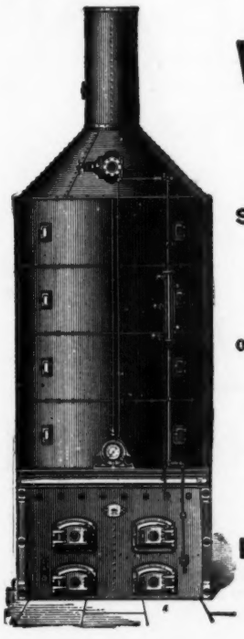

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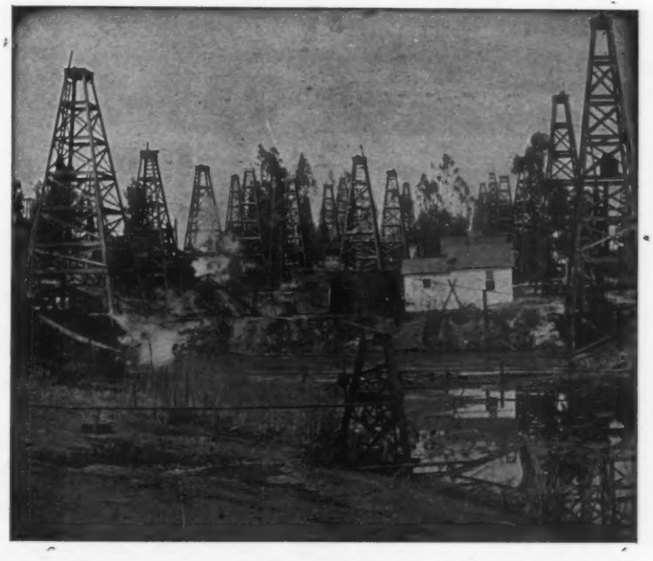

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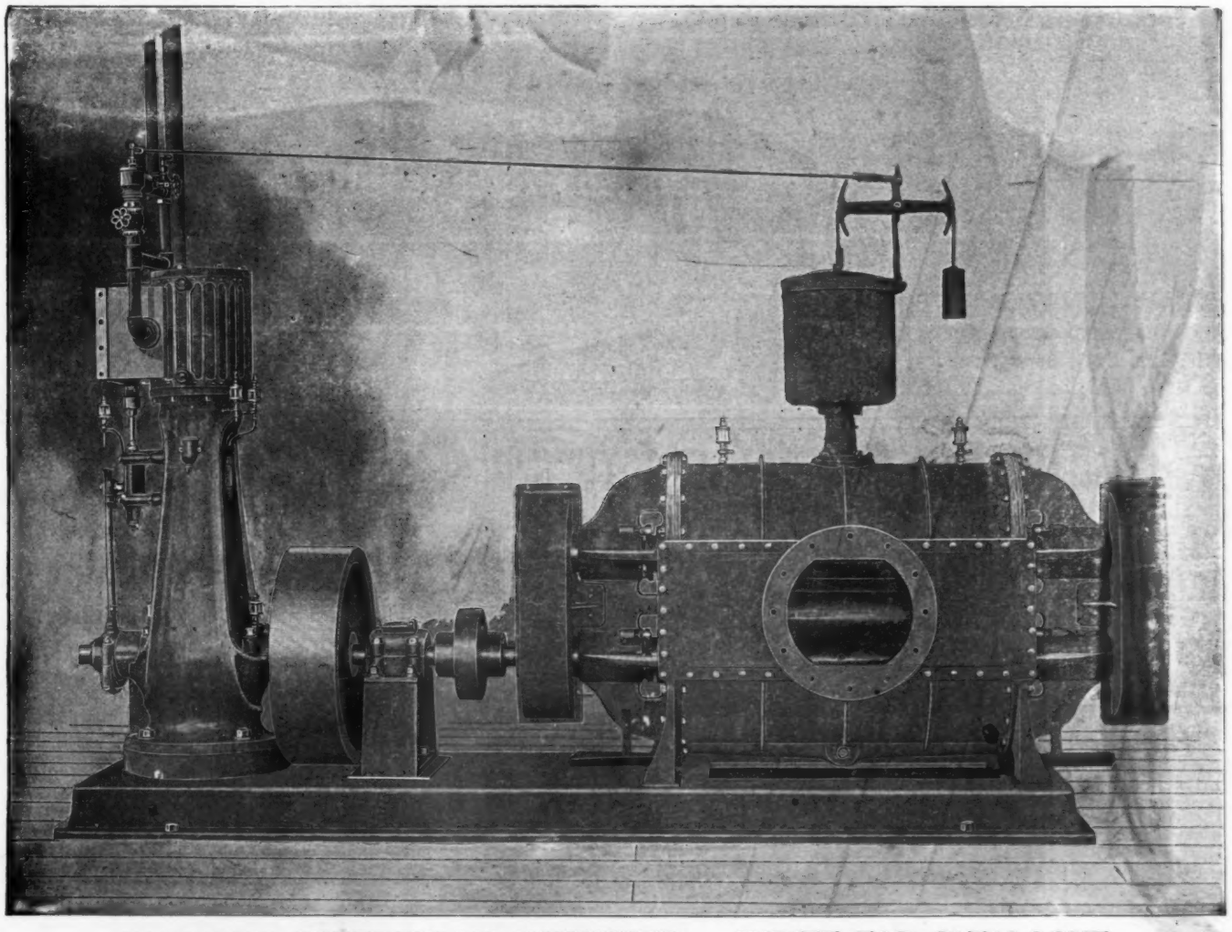

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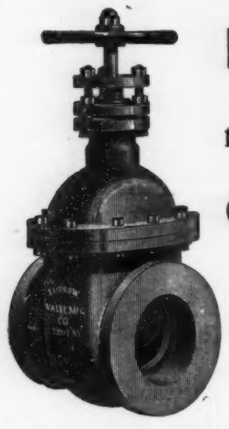

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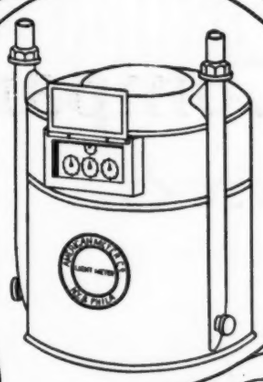

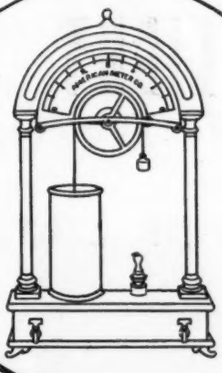

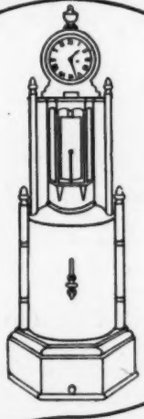

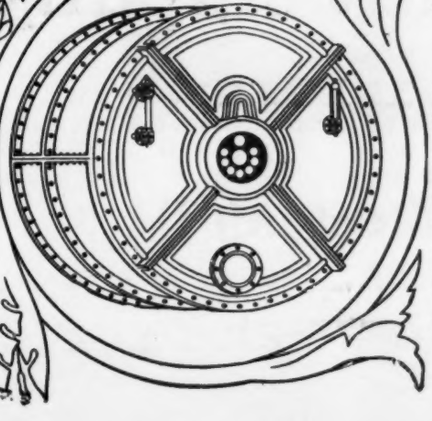

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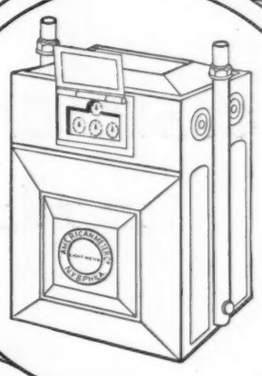
PUBLIC LIGHTING TABLE.

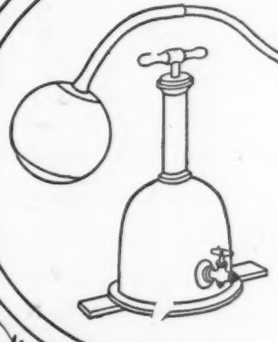
JANUARY, 1899.

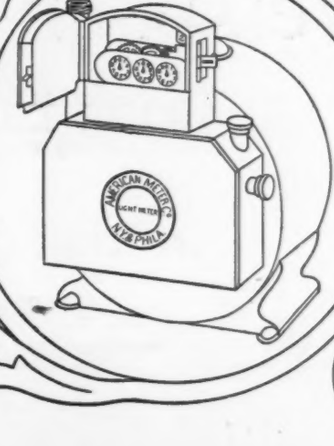
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	5.20 PM	10.20 PM	4.30	6.30
Mon.	2	5.20	11.20	4.30	6.30
Tue.	3	5.20	12.20 AM	4.30	6.30
Wed.	4	5.20 LQ	1.30	4.30	6.30
Thu.	5	5.20	2.30	4.30	6.30
Fri.	6	5.20	3.40	4.30	6.30
Sat.	7	5.20	4.50	4.30	6.30
Sun.	8	5.20	6.20	4.40	6.30
Mon.	9	5.20	6.20	4.40	6.30
Tue.	10	5.20	6.20	4.40	6.30
Wed.	11	5.20 NM	6.20	4.40	6.30
Thu.	12	5.20	6.20	4.40	6.30
Fri.	13	5.20	6.20	4.40	6.30
Sat.	14	5.20	6.20	4.40	6.30
Sun.	15	5.30	6.20	4.50	6.25
Mon.	16	10.00	6.20	4.50	6.25
Tue.	17	11.10	6.20	4.50	6.25
Wed.	18	12.10 AM FQ	6.20	4.50	6.25
Thu.	19	1.20	6.20	4.50	6.25
Fri.	20	2.20	6.20	4.50	6.25
Sat.	21	3.20	6.20	4.50	6.25
Sun.	22	4.00	6.20	5.00	6.25
Mon.	23	4.50	6.20	5.00	6.25
Tue.	24	5.20	6.20	5.00	6.25
Wed.	25	No L.	No L.	5.00	6.25
Thu.	26	No L. FM	No L.	5.00	6.25
Fri.	27	No L.	No L.	5.00	6.25
Sat.	28	5.40 PM	8.20 PM	5.00	6.25
Sun.	29	5.50	9.20	5.05	6.15
Mon.	30	5.50	10.20	5.05	6.15
Tue.	31	5.50	11.20	5.05	6.15

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150 30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45







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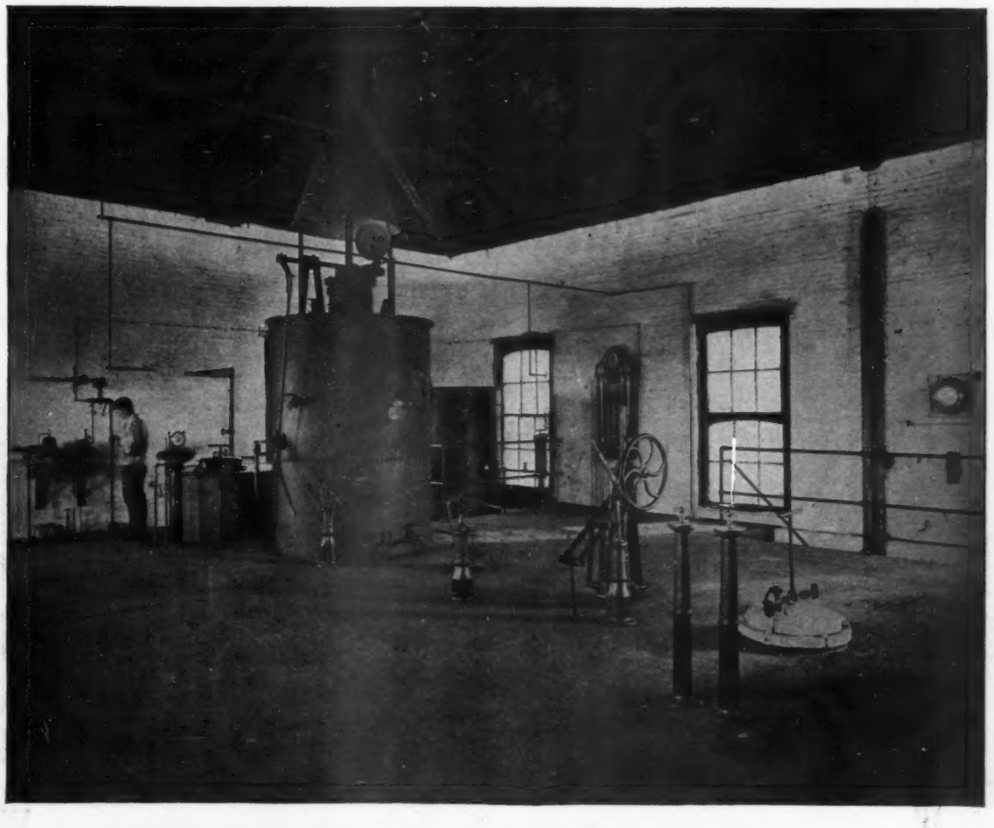

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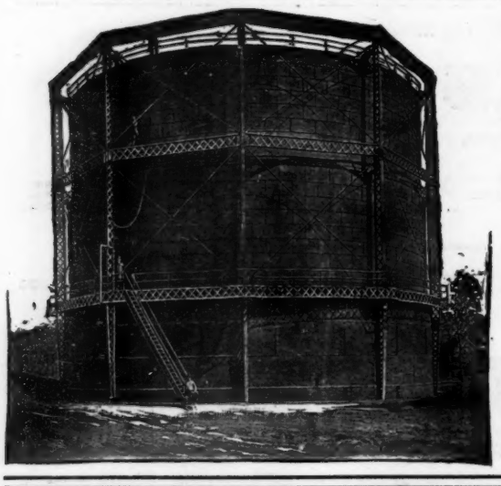

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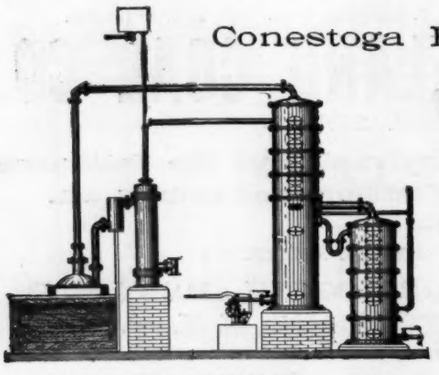

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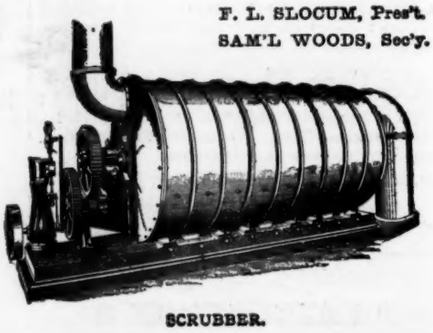

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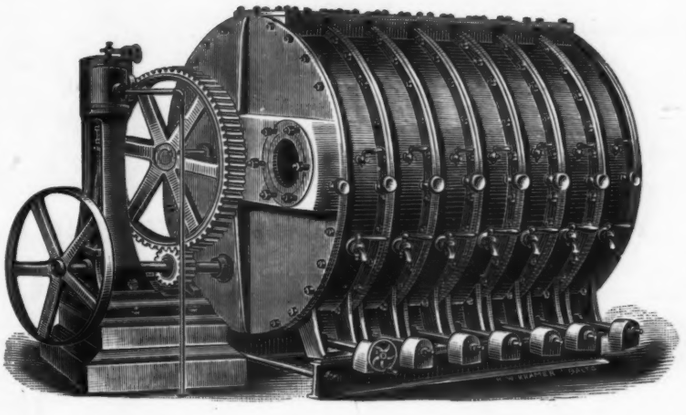

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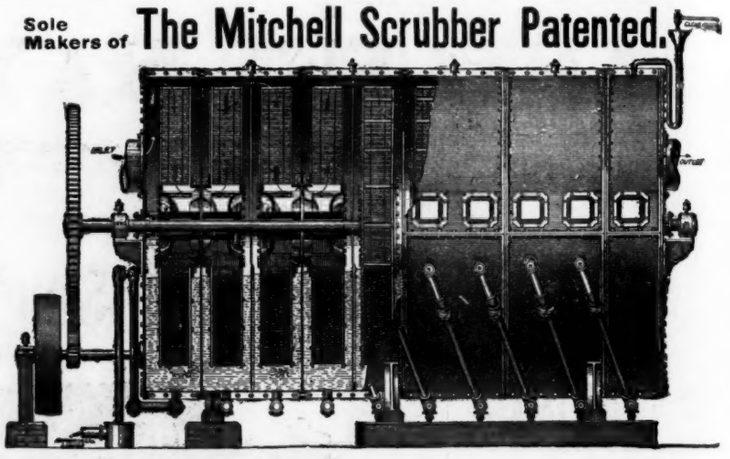

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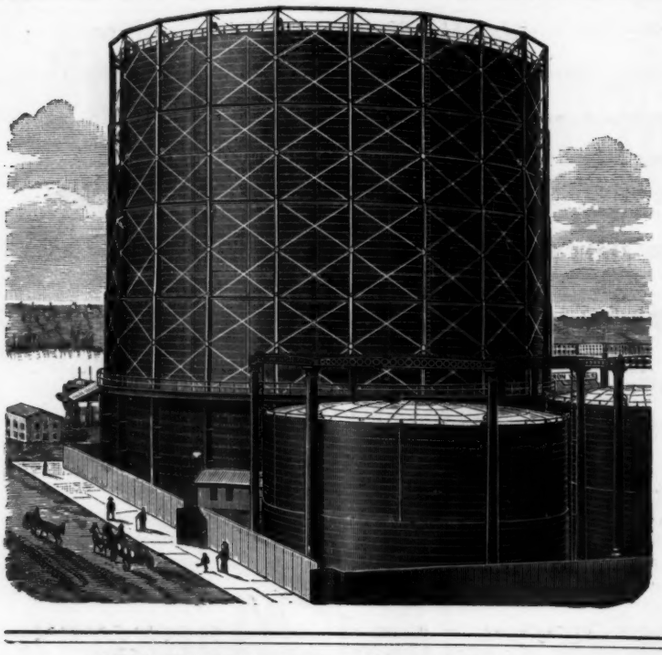

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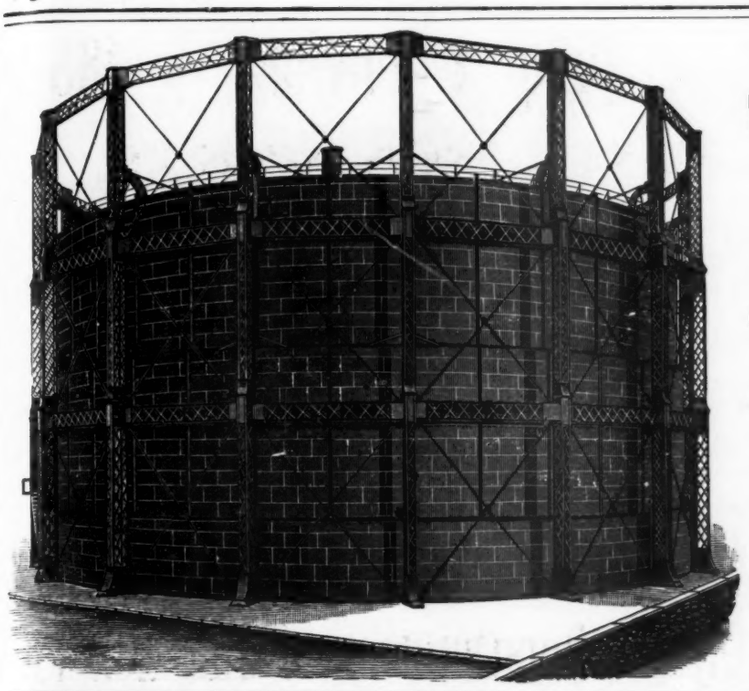

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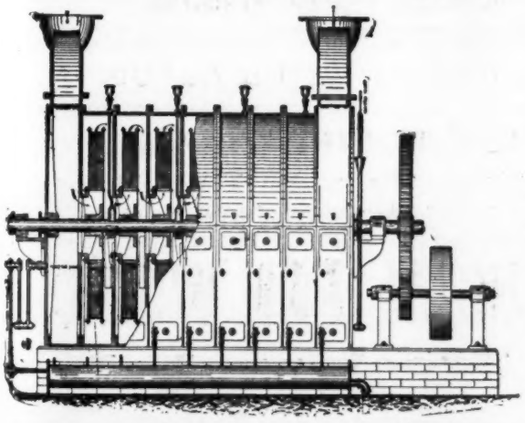

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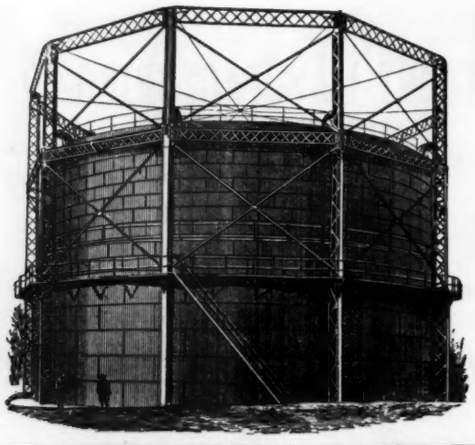

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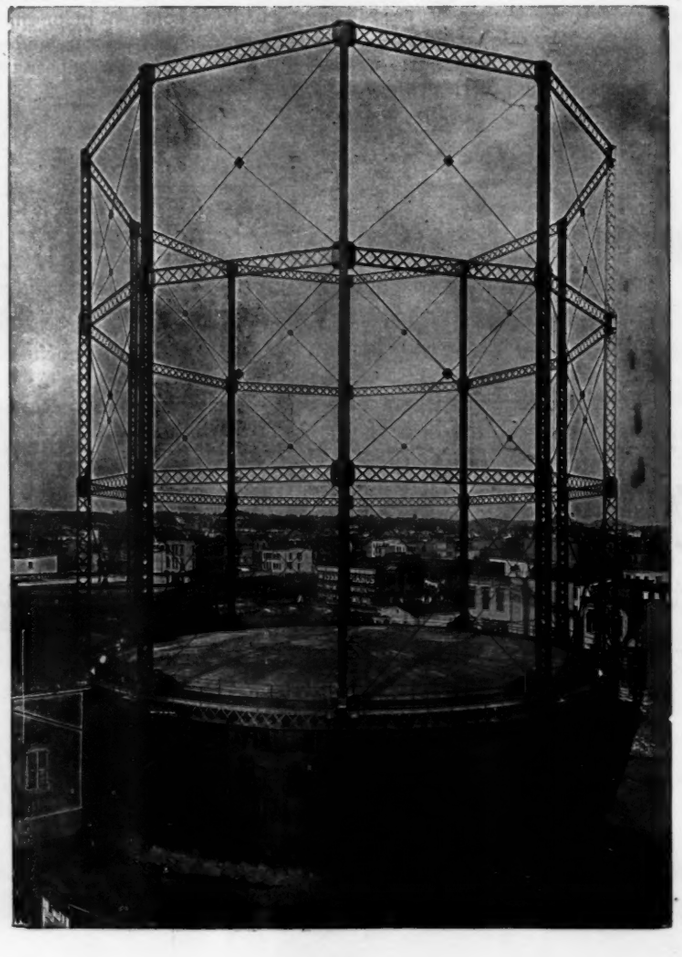

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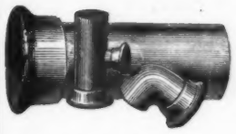

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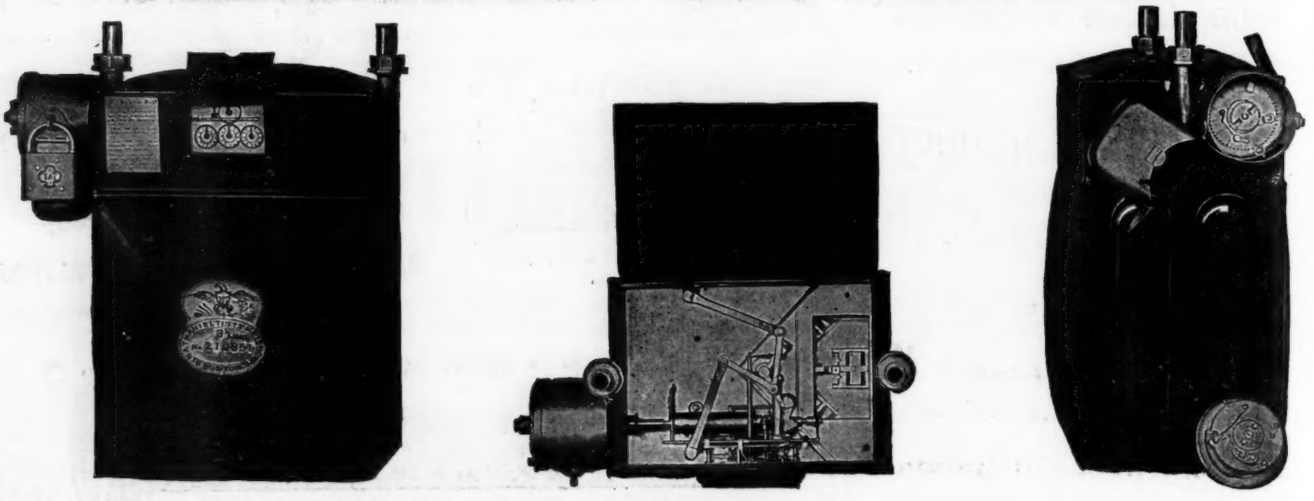

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